





RECORDS

of the

INDIAN MUSEUM

(A JOURNAL OF INDIAN ZOOLOGY)

Vol. V, 1910.

EDITED BY
THE SUPERINTENDENT
OF THE
INDIAN MUSEUM.

Calcutta:

PUBLISHED BY ORDER OF THE TRUSTEES OF THE INDIAN MUSEUM.
PRINTED AT THE BAPTIST MISSION PRESS.

1910.

3175 (9)
10

3816

LIST OF AUTHORS.

- Alcock, A., F.R.S. .. On the classification of the Potamonidae (Telphusidae), p. 253.
- Annandale, N., D.Sc. .. Notes on freshwater sponges, No. XII, p. 31.—Materials for a revision of the Phylactolaematous Polyzoa of India, p. 37.—An undescribed Burmese frog allied to *Rana tigrina*, p. 79.—An albino owl, p. 81.—Description of a new species of *Scalpellum* from the Andaman Sea, p. 115.—A new genus of Psychodid Diptera from the Himalayas and Travancore, p. 141.—The Indian barnacles of the subgenus *Smilium*, with remarks on the classification of the genus *Scalpellum*, p. 145.—Description of a South Indian frog allied to *Rana corrugata* of Ceylon, p. 191.—Contributions to the fauna of Yunnan, Part I, Sponges and Polyzoa, p. 197.—Notes on the Darjiling skink (*Lygosoma sikkimense*), p. 201.—Cockroaches as predatory insects, p. 201.—Two barnacles of the genus *Dichelaspis* new to Indian seas, p. 213.—Note on slugs from the Eastern Himalayas, p. 214.
- Beebe, C. W. Catalogue of the pheasants, peafowl, jungle fowl and spur fowl in the Indian Museum, p. 263.
- Chaudhuri, B. L., B.Sc. .. Description of a new species of *Nemachilus* from Northern India, p. 183.
- Coggin Brown, J., B.Sc. .. Contributions to the fauna of Yunnan, Introduction, p. 193.
- Distant, W. L. .. Rhynchota Malayana, Part III, p. 313.
- Eliot, C., K.C.M.G. .. Notes on Nudibranchs from the Indian Museum, p. 247.
- Gravely, F. H., M.Sc. .. On a subspecies of *Scutigerella unguiculata*, Hansen, found in Calcutta, p. 157.—The distribution of the Oriental Scolopendridae, p. 161.—*Alluaudella himalayensis*, a new species of degenerate (♂) cockroach, with an account of the venation found in the genera *Cardax* and *Alluaudella*, p. 307.
- Henderson, J. R., F.L.S. On certain species of *Palaemon* from South India, p. 277 (*in collaboration with Mr. George Matthai*).

	Page
XIV. The Indian barnacles of the subgenus <i>Smilium</i> , with remarks on the classification of the genus <i>Scalpellum</i>	145
XV. On a subspecies of <i>Scutigera unguiculata</i> , Hansen, found in Calcutta	157
XVI. The distribution of the Oriental Scolopendridae ..	161
XVII. Notes on Decapoda in the Indian Museum— I.—The species of <i>Gennadas</i>	173
XVIII. Description of a new species of <i>Nemachilus</i> from Northern India	183
XIX. Notes on the larvae of <i>Toxorhynchites immisericors</i> , Wlk.	187
XX. Description of a South Indian frog allied to <i>Rana corrugata</i> of Ceylon	191
XXI. Contributions to the Fauna of Yunnan— Introduction	193
Part I.—Sponges and Polyzoa	197
Miscellanea (pp. 201—215):—	
Notes on the Darjiling Skink (<i>Lygosoma sikkimense</i>) ..	201
Cockroaches as predatory insects	201
Note on <i>Aedeomyia squammipenna</i> , Arribalzaga ..	202
Named specimens of Chrysomelidae in the Indian Museum	202
Two barnacles of the genus <i>Dichelaspis</i> new to Indian Seas	213
Note on slugs from the Eastern Himalayas	214

PART IV, DECEMBER.

XXII. Notes and descriptions of Indian Microlepidoptera ..	217
XXIII. On some aquatic Oligochaete worms commensal in <i>Spongilla carteri</i>	233
XXIV. On <i>Bothrioneurum iris</i> , Beddard	241
XXV. Notes on Nudibranchs from the Indian Museum ..	247
XXVI. On the classification of the Potamonidae (Telphusidae)	253
XXVII. Catalogue of the pheasants, peafowl, jungle fowl and spur fowl in the Indian Museum	263
XXVIII. On certain species of <i>Palaemon</i> from South India ..	277
XXIX. <i>Alluaudella himalayensis</i> , a new species of degenerate (♂) cockroach, with an account of the venation found in the genera <i>Cardax</i> and <i>Alluaudella</i>	307
XXX. Rhynchota Malayana. Part III	313

LIST OF PLATES.



	<i>Follow page</i>
Plates I—III (Holothurians)	104
Plate IV (Hydroids)	30
Plate V (Ophiuridae)	88
Plate VI (Fish)	140
Plates VII and VIII (Oligochaetes)	78
Plates IX and X (Rats)	114
Plate XI (Oligochaetes)	240
Plate XII (Psychodidae)	144
Plates XIII and XIV (Decapoda)	182
Plates XV—XVIII (Prawns)	306
Plate XIX (Nudibranchs)	252
Plate XX (Cockroaches)	312
Plates XXI and XXII (Rhynchota)	338

CONTENTS.



PART I, MAY.

	<i>Page</i>
I. The Hydroids of the Indian Museum—	
No. I.—The deep-sea Collection	I
II. Notes on Freshwater Sponges—	
No. XII.—Description of a new species from Cape Comorin	31
III. Descriptions of new shells in the collection of the Indian Museum from Burma, Siam and the Bay of Bengal	33
IV. Materials for a revision of the Phylactolaematous Polyzoa of India	37
V. Studies on the aquatic Oligochaeta of the Punjab ..	59
VI. An undescribed Burmese frog allied to <i>Rana tigrina</i>	79
Miscellanea (pp. 81, 82):—	
Notes on the occurrence of <i>Vultur monachus</i> in Calcutta	81
An albino owl	81
“ <i>Matla bengalensis</i> ”: a correction	82

PART II, JUNE.

VII. Description d'Ophiures nouvelles provenant des der- nières campagnes de “l'Investigator” dans l'Océan Indien	83
VIII. Description d'Holothuries nouvelles appartenant au Musée Indien	89
IX. Further observations on the races of Indian rats ..	105
X. Description of a new species of <i>Scalpellum</i> from the Andaman Sea	115
XI. Descriptions of five new species of marine shells from the Bay of Bengal	117
XII. Notes on Fish from India and Persia, with descriptions of new species	123

PART III, SEPTEMBER.

XIII. A new genus of Psychodid Diptera from the Hima- layas and Travancore	141
---	-----

- Jenkins, J. T., D.Sc. .. Notes on fish from India and Persia, with descriptions of new species, p. 123.
- Kemp, S., B.A. .. Notes on Decapoda in the Indian Museum, I. The species of *Gennadas*, p. 173.
- Koehler, R. .. Description d'Ophiures nouvelles provenant des dernières campagnes de "l'Investigator" dans l'Océan Indien, p. 83.—Description d'Holothuries nouvelles appartenant au Musée Indien, p. 89 (*in collaboration with Prof. C. Vaney*).
- Lloyd, Capt. R. E., D.Sc. Further observations on the races of Indian rats, p. 105.
- Matthai, George, M.A. .. On certain species of *Palaemon* from South India, p. 277 (*in collaboration with Dr. J. R. Henderson*).
- Maulik, S. .. Named specimens of Chrysomelidae in the Indian Museum, p. 202.
- Meyrick, E., F.R.S. .. Notes and descriptions of Indian Microlepidoptera, p. 217.
- Paiva, C. A. .. Notes on the larvae of *Toxorhynchites immisericors*, Wlk., p. 187.—Note on *Aedeomyia squamipenna*, Arribalzaga, p. 202.
- Preston, H. B., F.Z.S. .. Descriptions of new shells in the collection of the Indian Museum from Burma, Siam and the Bay of Bengal, p. 33.—Descriptions of five new species of marine shells from the Bay of Bengal, p. 117.
- Ritchie, J., B.Sc. .. The Hydroids of the Indian Museum, No. I. The deep-sea collection, p. 1.
- Stephenson, Major J. .. Studies on the aquatic Oligochaeta of the Punjab, p. 59.—"*Matla bengalensis*": a correction, p. 82.—On some aquatic Oligochaete worms commensal in *Spongilla carteri*, p. 233.—On *Bothrioneurum iris*, Beddard, p. 241.
- Stuart-Baker, E. C., F.Z.S. Notes on the occurrence of *Vultur monachus* in Calcutta, p. 81.
- Vaney, C. .. Description d'Holothuries nouvelles appartenant au Musée Indien, p. 89 (*in collaboration with Prof. R. Koehler*).



ERRATA.

- Page 47, line 23. For "defected" read "defective."
- „ 51, „ 4. „ "vertical" read "horizontal."
- „ 134, „ 12. „ "*C. bilineata*" read "*P. bilineata*."
- „ 137, „ 6. „ "centimetre" read "millimetre."
- „ 148, „ 14 from bottom. For "fine" read "five."
- „ 224, „ 14. For "*Endrosis lactcella*" read "*Endrosis lacteëlla*."
- „ 229, „ 1. „ "*Arcrolepia*" read "*Acrolepia*."
- „ 229, „ 14 from bottom. For "*Orostega*" read "*Opostega*."
- „ 231, „ 4 „ „ „ "*Pylactis*" read "*Pyloetis*."

INDEX.



N.B.—An asterisk (*) preceding a line denotes a new variety or subspecies; a dagger (†) indicates a new species; and a double-dagger (‡), a new genus: in the case of synonyms the page numbers are printed in *Italics*.]

A		<i>Page</i>		<i>Page</i>
†Abgarus ..	..	313	Amphiura intermedia ..	86
†typicus ..	..	314	praestans ..	86
Abirus andamansis ..	..	212	Amphorina ..	249
angustatus ..	..	212	Anabas scandens ..	138
Abramis microlepis ..	..	126	Anacampsis nerteria ..	220
Acanaloniinae ..	..	320	Anacanthiini ..	132
Acanthopsis aurata ..	..	126	Anodontostoma ..	168
linea ..	..	127	octosulcatum ..	168, 170
Acanthopterygii ..	131, 135, 138		Antenella ..	14
Acanthotelpusa ..	253, 254, 257, 258		gracilis ..	14, 15
Acomus erythrophthalmus ..	..	266	natalensis ..	14, 15
pyronotus ..	..	267	secundaria ..	3, 14, 15
Acrocercops convoluta ..	..	227	Aoria bowringi ..	211
†Acrolepia nitrodes ..	..	229	nigripes ..	211
pygmaeana ..	..	229	Aphelodactyla ..	97
Aedeomyia squammipenna ..	..	202	(Haplodactyla) molpadi-	
Aegeriadae ..	..	219	oides ..	102
Aeolidiella ..	..	249	Apogon bifasciatus ..	131
Aethalotus ..	..	314	Arfaka ..	318
afzelii ..	..	314	decisa ..	318
†borneensis ..	..	314	Argusianus argus ..	274
Aetheomorpha nigropicta ..	..	206	Argyroploce aprobola ..	218
Aëtobatis flagellum ..	..	135	citharistis ..	219
Afakia ..	..	318	illepida ..	218
decisa ..	..	318	Arius dussumieri ..	131
Aglaophenia ..	1, 17, 22		jatus ..	140
balei ..	..	22	Arctrophora ombrodelta ..	218
crispata ..	..	19	Asanda ..	168
philippina ..	..	20	brevicornis ..	168, 171
phoenicea ..	..	21	Aspidolopha melanophthalma ..	207
rostrata ..	..	22	rugosa ..	206
secunda ..	..	19	Astrotoma ..	83, 88
septata ..	..	3, 15	agassizi ..	88
Ailia coila ..	..	140	bellator ..	88
Alburnus doriae ..	..	126	murrayi ..	88
eichwaldii ..	..	126	†rigens ..	86
maculatus ..	..	127	vecors ..	88
Alcyonella benedeni ..	42, 47—49		Atella ..	330
fungosa ..	..	44	cicatricosa ..	330
Alluaudella ..	307, 308, 311		cruentata ..	331
cavernicola ..	307, 309—311		gemmafera ..	330
†himalayensis ..	307—311		Athene brama ..	81
Ambassis baculis ..	..	138	Atracis ..	336
ranga ..	..	138	conserta ..	336
Amphibia ..	..	123	?fasciata ..	337
Amphichaeta ..	..	66	intercepta ..	336
Amphioplus ..	..	86	puncticeps ..	336
Amphiura ..	..	83	pyralis ..	336
†famula ..	..	85, 86	†rivarialis ..	336
			surrecta ..	336

	Page
Atracis surrecta var. a	.. 336
vetusta ..	.. 336
Aulophorus palustris	.. 74
Austenia annandalei	214, 215
sikkimense var. main-	
waringi ..	.. 214
†Australella ..	.. 40
lendenfeldi ..	.. 55
Aves ..	.. 123
†Avicula smithi ..	.. 35

B

Bagarius yarrellii ..	.. 140
Barbus amphibius ..	135, 136
bampurensis ..	.. 128
barbulus ..	.. 127
cyri ..	.. 126
microlepis ..	.. 127
miliaris ..	.. 126
sarana ..	.. 140
tetrapupagus ..	.. 138
Barytelphusa ..	.. 260
Bathyploetes assimilis	92, 94
†cinctus	89, 91, 92, 94
natans ..	.. 94
patagiatus ..	.. 92
phlegmaticus ..	.. 94
†roseus	89, 92, 94
Batrachidae ..	.. 132
Batrachus grunniens ..	.. 132
Belone strongylura ..	131, 135
Benthescymus ..	174, 179—181
? carinatus ..	.. 179
Bidis ..	.. 337
pictula ..	.. 337
punctifrons ..	.. 338
?Bimeria vestita ..	.. 249
Blattidae ..	.. 338
Bochara ..	.. 337
Bohemilla ..	.. 66
Borkhausenia pseudospretella	.. 224
Bothrioneuron iris ..	.. 241
Bothrioneuron iris ..	241—246
Bougainvillea ramosa	.. 4
sp. ..	.. 3, 4
Bougainvillidae ..	.. 3, 4
Brachmia autonoma ..	.. 222
†elephantopa ..	.. 222
†gradata ..	.. 221
†sigillatrix ..	.. 222
Brachycarpus ..	.. 278
Branchiodrilus ..	59—62, 64, 65
semperi ..	.. 59
Brenthia elatella ..	.. 226
†Brunettia ..	141, 142, 144
superstes ..	142, 144
†travancorica ..	.. 144
Bungia nigrescens ..	.. 127

C

Calantica ..	.. 149
Callichrous pabo ..	.. 137

	Page
Calophasis ellioti ..	.. 271
humiae ..	.. 271
Calyplostastea ..	.. 4
Cambarus ..	.. 279
Campanularia corrugata	2—5, 11
gracillima ..	.. 8
juncea ..	.. 8
mutabilis ..	.. 4, 5
sp. ..	.. 3, 6
?spinulosa ..	.. 3, 5
Campanularidae ..	.. 3, 4
Camptosomes ..	203, 206
Capitella capitata ..	.. 82
Capitellidae ..	.. 82
Capoëta amir ..	.. 127
Capsidae ..	.. 315
Carangidae ..	132, 136
Caranx djedaba ..	.. 136
gallus ..	.. 132
hippos ..	.. 132
ire ..	.. 136
rotterli ..	.. 132
sansun ..	.. 132
Carcharias melanopterus ..	.. 135
Carchariidae ..	.. 135
Cardax ..	307, 308, 311
willeyi ..	307—311
Cassis ..	.. 34
Catara ..	338, 338
philippinensis ..	.. 338
subdivisa ..	.. 338
Catreus wallichii ..	.. 272
Ceratobasis nair ..	.. 208
Cercopidae ..	.. 338
Chaetobranchus ..	.. 59
Chaetogaster ..	64, 68, 234
diastrophus ..	.. 68
orientalis ..	66—68, 70
pellucidus ..	.. 68
spongillae ..	.. 234
Chanos salmones ..	.. 131
Chatoessus chacunda ..	.. 131
nasus ..	131, 135, 136
Chaturbuja ..	.. 321
Chorinemus moadetta ..	.. 132
toloo ..	.. 132
Chromodoris albopustulosa ?	247, 251, 252
nodulosa ..	.. 252
pantherina ..	.. 252
papulosa ..	.. 252
pustulans ..	.. 252
scabriuscula ..	.. 252
verrucosa ..	.. 252
Chrysolophus amherstiae ..	.. 272
pictus ..	.. 272
Chrysomelidae ..	202, 203
Chrysophrys berda ..	131, 135, 136
datnia ..	.. 131
sarba ..	131, 135
Cicada pustulata ..	.. 331
Cicadidae ..	.. 316
†Circumdaksha ..	.. 328
†rufosquarosa ..	.. 328
Cirrhina ..	.. 126
afghana ..	126, 127
mrigala ..	.. 138

	Page		Page
Cirripedia ..	150, 214	Cormocephalus philippinensis	168, 170
†Cladarodes ..	.. 229	pygmaeus	164, 168, 171
†peloptera ..	.. 230	rubriceps ..	164
Clupea alosa ..	138, 139	westwoodi ..	164
brachysoma ..	.. 131	Corynoides amethystinus ..	213
chapra ..	.. 140	andamanensis ..	213
finta ..	138, 139	peregrinus ..	213
ilisha ..	138, 140	pyrophorus ..	213
lile ..	131, 135	pyrospilotus ..	213
longiceps ..	.. 131	sheppardi ..	213
sapidissima ..	138, 139	undatus ..	213
sindensis ..	.. 131	Cosmopterygidae ..	223
variegata ..	.. 138	Cosmopteryx asiatica ..	223
Clupeidae ..	131, 135, 138	basilisca ..	223
Clytia johnstoni ..	.. 6	hamifera ..	223
Clytra insularis ..	.. 207	Cottidae ..	132
lefevrei ..	.. 207	Cratena ..	249
orientalis ..	.. 207	bylgia ..	249
succincta ..	.. 207	Criocerinae ..	203
Clytrasoma palliata ..	.. 207	Crioceris cruciata ..	206
Clytrinae ..	.. 206	impressa ..	205
Cobitidinae ..	128, 138	quadripustulata ..	205
Cobitis persa ..	.. 127	semicostata ..	205
Colasposoma affine ..	.. 212	semipunctata ..	205
albovillosum ..	.. 211	Cristatella mucedo ..	39
aureovittatum ..	.. 212	Cristatellidae ..	38, 39
auripenne ..	.. 212	Cromna centralis ..	331
caeruleatum ..	.. 211	chlorospila ..	324, 333-335
downesi ..	.. 211	frontalis ..	325
metallicum ..	.. 211	obtusa ..	335
nitida ..	.. 212	peracuta ..	332, 337
ornatum ..	.. 212	quadripunctata ..	324
Colgar ..	324, 325, 330	surrecta ..	325
bistriguttata ..	.. 330	Crossoptilon manchuricum ..	267
calochroma ..	.. 331	Crustacea ..	213
cicatricosa ..	.. 331	Cryptaustenia succinea ..	215
conficita ..	.. 331	Cryptocephalinae ..	208
cruentata ..	.. 331	Cryptocephalus analis ..	210
diversa ..	.. 331	colon ..	210
gemmifera ..	.. 330	deficiens ..	209
ocellifera ..	.. 331	dimidiatipennis ..	209
pustulata ..	.. 331	interjectus ..	210
quadriguttata ..	.. 328	konbirensis ..	208
?semilata ..	.. 331	posticalis ..	208
?volens ..	.. 334	pusaensis ..	209
†Colgaroides ..	.. 324	sehestedti ..	209
acuminata ..	.. 325	senarius ..	210
feveretti ..	.. 325	sexsignatus ..	209
Colobesthes exaltata ..	.. 325	sikhimensis ..	209
falcata ..	.. 322	tricinctus ..	209
rectilinea ..	.. 332	vittipennis ..	209
Colochirus ..	.. 98	Cryptolaria operculata ..	3, 9, 10
violaceus ..	.. 101	†Cryptolechia stomota ..	224
Colsa ..	.. 338	Cryptophlebia carpophaga ..	218
matanga ..	.. 338	illepida ..	218
Conchoderma ..	.. 148	Cryptops ..	161, 166
Considia ..	338, 338	doriae ..	166, 170
cavata ..	.. 338	faeae ..	166, 171
Coptocephala dimidiatipennis ..	.. 208	inermipes ..	166, 170
dubia ..	.. 208	loriae ..	166
Corbicula ..	.. 198	modigliani ..	166, 170
Cormocephalus ..	164, 168	Cucumaria ..	97
dentipes ..	164, 168, 171	ardens ..	100
dispar ..	169, 171	ariana ..	98
var. sarasi-		†digitata ..	89, 96, 97
norum ..	169, 171	†imbellis ..	89, 97, 98
inermipes ..	169, 171	incurvata ..	96

	<i>Page</i>		<i>Page</i>
Cucumaria inflexa ..	97, 99, 100	Dichelaspis nierstraszi ..	214
†mosaica ..	89, 98, 99	orthogonia ..	214
†perdita ..	89, 99, 100	Dilocarcinus ..	253
pigra ..	.. 100	Diphasia mutulata ..	3, 12, 14
rapax ..	99, 100	thornelyi ..	3, 13
Cucumariidae ..	89, 96, 101	Diplonema ..	141, 141
Culex ..	187, 189	superstes ..	142
Cuthona ..	.. 249	Diptera ..	.. 141
†annandalei ..	247, 248	Discognathus ..	.. 124
Cybium commersonii ..	.. 132	lamta ..	124, 127, 128
Cyclica ..	203, 210	variabilis ..	.. 127
Cylindrotelphusa ..	.. 259	†Dolium varicosum ..	.. 34
Cynoglossus ..	129, 130	Donacia aeraria ..	203
†acinaces ..	.. 130	recticollis ..	203
bengalensis ..	.. 130	Donaciinae ..	.. 203
†deltae ..	.. 130	Doris ..	.. 251
elongatus ..	.. 130	pustulosa ..	.. 251
lida ..	.. 130	(Staurodor) pustulata ..	247, 251
lingua ..	.. 130	verrucosa ..	.. 251
puncticeps ? ..	.. 132	Drepane punctata ..	.. 131
Cyprinidae ..	124, 128, 135, 138	†Drillia ganjamensis ..	.. 117
Cyprinae ..	.. 128		
Cyprinion kirmanense ..	.. 128		
Cyprinodon ..	.. 124		
†blanfordii ..	124, 125		
dispar ..	.. 127		
†persicus ..	125, 126		
†pluristriatus ..	125, 126		
punctatus ..	125, 127		
sophiae ..	125, 127		
Cyprinodontidae ..	123, 135		
		E	
		Elacate nigra ..	.. 132
		†Elachista ithygramma ..	.. 225
		†nearcha ..	.. 225
		thallophora ..	.. 225
		Elachistidae ..	.. 225
		Elasmobranchii ..	.. 135
		Elidiptera puncticeps ..	.. 336
		Elops saurus ..	.. 135
		Elpidiidae ..	89, 95
		Embia ..	.. 307
		Encephaloides armstrongi ..	.. 154
		Endrosia lactea ..	.. 224
		Engraulis malabaricus ..	.. 135
		mystax ..	.. 135
		talara ..	.. 140
		Enypniastes ..	.. 96
		†?decipiens ..	89, 95, 96
		eximia ..	.. 96
		†Epermenia chelyodes ..	.. 228
		Epicephala albifrons ..	.. 227
		†bromias ..	.. 227
		Epilobocera ..	.. 253
		Epimela indica ..	.. 207
		†Epithectis oscophora ..	.. 219
		†telifera ..	.. 220
		Epizoanthus sp. ..	.. 4
		Equula blochii ..	.. 136
		brevirostris ..	.. 132
		edentula ..	.. 136
		fasciata ..	.. 132
		insidiatrix ..	.. 132
		Ereunetis xenica ..	.. 230
		Erimetopus ..	253, 254, 257, 258
		Ethmostigmus ..	.. 163, 168
		albibus ..	168, 171
		bisulcatus ..	168, 170
		platycephalus ..	163, 168, 170
		pygomegas ..	163, 168, 171
		rubripes ..	163, 168, 170
		sp. ..	.. 163
		spinosis ..	163, 168, 171

	Page
† <i>Eucosma balanoptycha</i> ..	218
Eucosmidae ..	218
Eudendridae ..	3
Eudendrium ramosum ..	4
sp. ..	3
Eumolpinae ..	210
Eupalaemon ..	278
Euphanta ..	324
chloropila ..	324
monoleuca ..	324
munda ..	324
†pokiana ..	324
quadripunctata ..	324
Eupodes ..	203
Eupyrigus ..	97
Euriplastes ..	96
obscura ..	96
Eurybrachys conserta ..	336
intercepta ..	336
surrecta ..	336
vetusta ..	336
Eurypelta modesta ..	212

F

Ficarasa ..	337
pallida ..	337
simplex ..	337
Flata (Colobesthes) pryeri ..	327
cruentata ..	331
flaccida ..	321
floccosa ..	321
quadriguttata ..	328
rubescens ..	321
subacuta ..	320
Flatinae ..	321, 335, 337
Flatoides fasciatus ..	337
plagiatus ..	335
semialbus ..	335
simplex ..	337
Flatosoma ..	321
comma ..	321
†melichari ..	321
signoreti ..	321
†Franciscus ..	337
fasciatus ..	337
Fredericella ..	39
australiensis ..	39
cunningtoni ..	39
indica ..	39, 40
sultana ..	39
Fredericellinae ..	38, 39
Fulgora truncata ..	322
Fulgoridae ..	313, 318, 320, 338

G

Galloperdix bicalcarata ..	264
lunulata ..	263
spadicea ..	263
Gallus gallus ..	272, 273
lafayettii ..	273
"pseudhermaphroditus" ..	273
sonnerati ..	273
varius ..	273

Gargamella ..	250
Gazza aequiliformis ..	136
Gecarcinucinae ..	253—256, 258—260
Gecarcinucus ..	253, 254, 259
Gelechiidae ..	219
Gennadas ..	173, 174, 179—181
†alcocki ..	174, 176, 177
alicei ..	180
bouvieri ..	179
carinatus ..	174, 179
clavicarpus ..	173
parvus ..	175, 177
pasithea ..	173
†praecox ..	176
scutatus ..	174, 178
†sordidus ..	177
Gennaeus albocristatus ..	267
andersoni ..	269
cuvieri ..	269
horsfieldi ..	268
leucomelanus ..	268
lineatus ..	269
melanonotus ..	268
nycthemerus ..	269
oatesi ..	269
swinhoii ..	269
Geotelphusa ..	253, 255, 257, 258
enodis ..	258
Gerres lucidus ..	131, 135
Globitelphusa ..	260
Glyphidodontidae ..	132
Glyphipterygidae ..	226
Glyptosternum pectinopterum ..	129
†saisii ..	128, 129
Gobiidae ..	132, 135, 136
Gobius ..	134
†chilkensis ..	136, 137
giuris ..	137, 140
macropus ..	126
striatus ..	135
Gonothyraea ..	5
longicyatha ..	6
Gracilaria octopunctata ..	227
†scansoria ..	227
Gracilariidae ..	226
Gunomys bengalensis ..	106
Gymnoblaster ..	3
Gynandrophthalma crassipes ..	206

H

Halecium halecinum ..	10
Halicornaria ..	22, 24
balei ..	3, 22, 23
var. flava ..	3, 23
flava ..	23
gracilicaulis ..	3, 5, 23
hians ..	22, 24
var. profunda ..	3, 24
plumosa ..	5
variabilis ..	25, 26
Haplochilus melanostigma ..	135—137, 140
panchax ..	135, 136
Hebella calcarata ..	7
crateroides ..	3, 6

	Page		Page
<i>Hebella lata</i> ..	7	<i>Lema bimaculata</i> ..	204
<i>Heliangara lampetis</i> ..	221	<i>coromandeliana</i> ..	204
† <i>macaritis</i> ..	221	<i>femorata</i> ..	205
<i>Hemidactylus flaviviridis</i> ..	201	<i>globicollis</i> ..	203
<i>Heminodes unicolor</i> ..	213	<i>impotens</i> ..	204
<i>Hemirhamphus limbatus</i> ..	135	<i>lacordairei</i> ..	204
<i>Hervia</i> ..	249	<i>lateralis</i> ..	204
<i>Heteroptera</i> ..	313	<i>lycaon</i> ..	204
<i>Holoptilinae</i> ..	315	<i>mandarensis</i> ..	205
<i>Holothuria atra</i> ..	101	<i>nigricollis</i> ..	205
<i>ocellata</i> ..	101	<i>palpalis</i> ..	204
<i>tenuissima</i> ..	101	<i>quadripunctata</i> ..	204
<i>Holothuriidae</i> ..	101	<i>terminata</i> ..	205
<i>Homoptera</i> ..	316	<i>Lemuriana</i> ..	317
<i>Hyalinella</i> ..	52	<i>apicalis</i> ..	317
<i>Hyalonema</i> ..	153, 154	† <i>connexa</i> ..	317
<i>Hydroida</i> ..	1	<i>Lepadidae</i> ..	148, 213
<i>Hydrotelphusa</i> ..	253, 257, 258	<i>Lepadocephalichthys guntea</i> ..	138
<i>Hygiops</i> ..	337	<i>Lepas scalpellum</i> ..	150
<i>Hypolobocera</i> ..	253	<i>Limnotelphusa</i> ..	253, 258
I		<i>Linguella</i> ..	247
<i>Iapyx</i> ..	157	<i>quadrilateralis</i> ..	247
<i>Ibla</i> ..	145	(<i>Sancara</i>) <i>quadrilateralis</i> ..	247
<i>Idia pristis</i> ..	2—5, 11	<i>Liotelphusa</i> ..	258, 260
<i>Idume</i> ..	335	† <i>Lithocolletis conformis</i> ..	226
<i>plicata</i> ..	335	<i>Lollius</i> ..	318
<i>Isometopinae</i> ..	315	<i>australicus</i> ..	318
<i>Issinae</i> ..	318	† <i>pryeri</i> ..	318
<i>Ithagenes cruentus</i> ..	264	† <i>Lombokia</i> ..	323
K		† <i>everetti</i> ..	323
† <i>Kayania</i> ..	334	<i>Lophophorus impeyanus</i> ..	266
<i>volens</i> ..	334	<i>sclateri</i> ..	266
<i>Kingsleya</i> ..	253	<i>Lophopinae</i> ..	338
L		<i>Lophopodella</i> ..	37, 41, 54, 56
<i>Labidostomis humeralis</i> ..	206	<i>capensis</i> ..	54
<i>Labyrinthici</i> ..	138	<i>carteri</i> ..	37, 54—56
<i>Lafoëa fruticosa</i> ..	8	<i>thomasi</i> ..	54
<i>gracillima</i> ..	3, 8	<i>Lophopus</i> ..	37, 40, 41, 54
var. <i>benthophila</i> ..	8	<i>carteri</i> ..	55
<i>magna</i> ..	5	<i>crystallinus</i> ..	54
<i>serrata</i> ..	3, 9	<i>jheringi</i> ..	54
<i>Lafoëidae</i> ..	3, 8	<i>lendenfeldi</i> ..	41, 55
† <i>Lahoria</i> ..	59, 65	var. <i>himalay-</i>	
† <i>hortensis</i> ..	59, 61, 63, 65	<i>anus</i> ..	55
† <i>Laspeyresia jaculatrix</i> ..	219	<i>Lophura ignita</i> ..	267
<i>Lates calcarifer</i> ..	131	<i>rufa</i> ..	267
<i>Lawana</i> ..	325, 326	<i>Lutjanus johnii</i> ..	131
<i>candida</i> ..	325	<i>lioglossus</i> ..	131
<i>exaltata</i> ..	325	<i>Lygaeidae</i> ..	313
† <i>modesta</i> ..	326	<i>Lygosoma sikkimense</i> ..	201
<i>optata</i> ..	325	<i>Lyonetia</i> ..	230
(<i>Phyma</i>) <i>hyalina</i> ..	326	<i>Lytocarpus</i> ..	24
<i>Lebias punctatus</i> ..	125	<i>annandalei</i> ..	3, 15, 17
<i>sophiae</i> ..	125	<i>gracilicaulis</i> ..	23
<i>Lecithocera itrinea</i> ..	220	<i>pennarius</i> ..	3, 13, 14, 19
† <i>triphthalma</i> ..	220	<i>philippinus</i> ..	3, 20
<i>Lema atkinsoni</i> ..	204	<i>phoeniceus</i> ..	3, 6, 7, 21
		<i>secundus</i> ..	19
M		M	
		<i>Macrobrachium</i> ..	278, 280
		<i>Macrones aor</i> ..	140
		<i>bleekeri</i> var. <i>burmanicus</i> ..	138
		<i>cavasius</i> ..	137, 140
		<i>vittatus</i> ..	135

	Page		Page
Mammalia ..	123	Nais bretscheri ..	235
Maotys guttifer ..	315	communis ..	66, 235, 239, 240
venosus ..	315	*var. caeca ..	235, 238
Margarya ..	195, 198	var. punjabensis ..	235, 237, 239, 240
†Martesia delicatula ..	119, 120	†pectinata ..	234, 236
Mastacembelus zebrinus ..	138	variabilis ..	235, 239, 240
"Matla" ..	82	var. punjabensis ..	66, 70, 73, 234
"bengalensis" ..	82	†Nassa ariel ..	118
Melicharia ..	322, 323	Nemachilus ..	183, 185
luteimargo ..	322	bampurensis ..	128
niveina ..	322	kessleri ..	127
quadrata ..	322	†mackenziei ..	183
tripars ..	322	rubidipennis ..	185
Merilia lunulata ..	206	sargadensis ..	128
Mesothuria multipes ..	100	savona ..	128
Microlepidoptera ..	217—232	Neocatara ..	338
Mimops ..	166	philippinensis ..	338
orientalis ..	166, 171	subdivisa ..	338
Mindura ..	319	†Neocromna ..	329
alligata ..	319	bistriguttata ..	330
†confusa ..	319, 320	†Neodaksha ..	328
†interrupta ..	320	quadriguttata ..	328
†simiana ..	320	Neomelicharia ..	330
Miopristis bimaculata ..	206	calochroma ..	331
"Mococa sacra" ..	201	conficita ..	331
Modiola evansi ..	36	consociata ..	330
†jenkinsi ..	36	cruentata ..	330, 331
Mogannia ..	317	erubescens ..	330
conica ..	317	marginalis ..	331
†moultoni ..	317	ocellifera ..	331
Molpadia (Aukyroderma) musculus ..	101	pustulata ..	331
musculus ..		Nephesa ..	332
var. acutum ..	102	albescens ..	335
(Trochostoma) andaman- ..		amata ..	333
ensis ..	101	amoena ..	331
granulata ..	101	bistriguttata ..	330
Molpadiidae ..	97, 101	brunnea ..	332
Monopis dicycla ..	231	calochroma ..	331
†sertifera ..	230	chlorospila ..	324
Monostaechas quadridens ..	14	cicatricosa ..	330
Mugil carinatus ..	132	conficita ..	331
corsula ..	140	consociata ..	330
cunnesius ..	132	decolor ..	333, 334
kelaartii ..	132	deducta ..	322
klunzingeri ..	132, 136	gemmifera ..	330
oeur ..	136	grata ..	332
olivaceus ..	136	intrusa ..	332
seheli ..	136	invasa ..	333
Mugilidae ..	132, 136	longipennis ..	332
Mus alexandrinus ..	108	lutea ..	321
blanfordi ..	106	marginalis ..	331
decumanus ..	109, 113	monoleuca ..	324
hibernicus ..	109	obtusa ..	335
rattus ..	105, 106, 108, 113	rectilinea ..	332
vicereus ..	113	rectimargo ..	332
Myliobatidae ..	135	rorida ..	332, 333
Myzomyia ..	189	rosea ..	332
rossii ..	189	roseigutta ..	331
		rufilinea ..	334
		†sandakanensis ..	333
		subjecta ..	335
		suffusa ..	332
		tripars ..	322
		truncaticornis ..	332
		volens ..	334
N			
Naididae ..	59, 64, 66, 70, 82, 233—235		
Naidium ..	65		
naidina ..	65		
Nais ..	62, 64—66, 68—70, 233, 234, 239		

	Page		Page
†Scalpellum lambda	115, 116	Scolopendrella	.. 157
longirostrum	.. 154	Scolopendridae	.. 161—172
rostratum	.. 153	Scombresocidae	.. 131, 135
(Scalpellum)	115, 147, 149, 150	Scombridae	.. 132
vulgare	150	Scopiastes	.. 314
(Smilium)	115, 145—155	Scutigerella	.. 157
acutum	151, 154	subunguiculata	157, 158
bengalense	151, 153	unguiculata	157, 158
peronii	.. 150	*subsp. indica	158
scorpio	.. 149	†Scythris expolita	.. 224
squamuliferum	150, 151	Sephena	.. 334
sociabile	.. 4, 6	albescens	.. 335
squamuliferum	6, 147, 149—154	consentanea	.. 335
subflavum	.. 149	obtusa	.. 335
velutinum	.. 148	rufilinea	.. 333, 334
Scaphiodon	.. 123, 124, 127	rufomarginata	.. 333
asmussi	.. 127	spargula	.. 334
†baluchiorum	.. 124	subjecta	.. 335
capoëta	.. 128	Serbana	.. 313
chebisiensis	.. 127	borneensis	.. 313
gracilis	.. 127	Serranus diacanthus	.. 131
heratensis	.. 127	lanceolatus	.. 131
irregularis	.. 124	Sertularella polyzonias	.. 10
macrolepis	.. 127	var. cornuta	3, 9, 10, 15
rostratus	.. 127	var. gracilis	.. 10
socialis	.. 128	var. robusta	.. 11
Scatophagus argus	.. 131	tricuspidata	.. 2
Scelodonta dillwyni	.. 211	Sertularia mutulata	.. 12
indica	.. 211	pennaria	.. 19
vittata	.. 210	secundaria	.. 14
†Schendylotis	.. 225	Sertularidae	.. 3, 9
†chrysota	.. 226	Sialoscarta	.. 338
Schizothorax	.. 126	cavata	.. 338
poelzami	.. 127	conciuna	.. 338
rawlinsii	.. 126	krugeri	.. 338
zaroudnyi	.. 127	Sillago sihama	132, 136
Sciaena albida	.. 136	Silundia gangetica	.. 140
belengeri	.. 131	Siluridae	128, 131, 135, 137, 140
cuja	.. 131	Simaethis fabriciana	.. 226
Sciaenidae	.. 131, 136	orthogona	.. 226
Sciaenoides pama	.. 140	Siphothuria	.. 97
Sclerodermi	.. 136	†Skapana	.. 315
Scolocryptops	.. 166	†typica	.. 316
broelemanni	166, 171	Slavina	.. 62, 66
Scolopendra	.. 164, 169	Solea	.. 133
canidens	.. 164	cyanea	.. 133
cingulata	165, 169—171	elongata	.. 133
gracillima	169, 170	heterorhina	.. 133
indica	.. 169, 171	indica	.. 133
morsitans	164, 169, 170	oculus	.. 134
pinguis	.. 169, 171	ovata	.. 133
subspinipes	165, 169, 170, 172	†sindensis	132, 133
var. dehaani	165, 169, 172	umbratilis	.. 133
var. hardwickei	166, 169, 172	Sparidae	131, 135
var. japonica	169	Sphyraena jello	.. 132
var. multident	169	Sphyraenidae	.. 132
var. mutilans	169	Spirochona	.. 241
var. spinosissima	169	Spongilla	.. 31
valida	164, 169, 171	bombayensis	.. 31
var. simonyi	169	carteri	233—235
		clementis	.. 199
		†coggini	198, 199

	Page
† <i>Nepticula oritis</i> ..	229
<i>Nodostoma concinnicolle</i> ..	210
<i>plagiosum</i> ..	210
<i>variabile</i> ..	210
<i>Nothris malacodes</i> ..	223
<i>Notopteridae</i> ..	134, 138
<i>Notopterus kapirot</i> ..	134, 138
<i>Nuria danrica</i> var. <i>alta</i> ..	138

O

<i>Obelia</i> ..	5
<i>Ocnus</i> ..	96
<i>Oecophoridae</i> ..	224
<i>Oligochaeta</i> 59—77, 82, 233, 239	
† <i>Oligophlebia amalleuta</i> ..	219
<i>Onebala agnatella</i> ..	221
† <i>Opeas innocens</i> ..	33, 34
<i>Ophiocephalidae</i> ..	128, 135, 138
<i>Ophiocephalus gachua</i> ..	127, 128
<i>marulius</i> ..	138
<i>punctatus</i> ..	138
<i>striatus</i> ..	135
<i>Ophioglypha</i> ..	83
<i>clemens</i> ..	84, 85
† <i>podica</i> ..	83, 85
<i>scutata</i> ..	84, 85
† <i>Opogona chalinota</i> ..	230
<i>flavofasciata</i> ..	230
† <i>percnodes</i> ..	230
† <i>Opotega chalcophylla</i> ..	229
<i>Ormenis</i> ..	323
† <i>baramia</i> ..	322
<i>deducta</i> ..	322
<i>obtusa</i> ..	323
<i>Orthostoma</i> ..	253
<i>Oryza</i> ..	322
<i>truncata</i> ..	322, 321
† <i>Oryxana</i> ..	320
<i>lutea</i> ..	321
<i>subacuta</i> ..	320
<i>Osteogeniosus militaris</i> ..	135, 136, 140
<i>Ostrea lentiginosa</i> ..	36
<i>Otocryptops</i> ..	166, 170
<i>melanostomus</i> ..	166, 170
var. <i>celebensis</i> ..	166
<i>rubiginosus</i> ..	166, 170, 171
<i>Otolithus ruber</i> ..	131
<i>Otostigmus</i> ..	161, 167
<i>aculeatus</i> ..	167, 170
<i>asper</i> ..	167, 170
<i>astenus</i> ..	167, 170
<i>carinatus</i> ..	162
var. <i>insulare</i> ..	162
<i>ceylonicus</i> ..	167, 171
<i>feae</i> ..	167, 171
<i>geophilinus</i> ..	167, 170
<i>insularis</i> ..	162, 167, 170
<i>longicornis</i> ..	167, 170
<i>metallicus</i> ..	167, 171
<i>morsitans</i> ..	167, 171
<i>multidens</i> ..	167, 170
<i>nemorensis</i> ..	167, 170
<i>niasensis</i> ..	167, 170
<i>nudus</i> ..	167, 171

	Page
<i>Otostigmus orientalis</i> ..	167, 171
<i>oweni</i> ..	167, 171
<i>politus</i> ..	161, 167, 170
<i>punctiventer</i> ..	167, 170
<i>rufriceps</i> ..	167, 171
<i>rugulosus</i> ..	162, 167, 171
<i>scaber</i> ..	167, 171
<i>sp.</i> ..	162
<i>spinulosus</i> ..	167, 170
<i>splendens</i> ..	167, 171
<i>sucki</i> ..	167, 170
<i>sumatranus</i> ..	167, 170
† <i>Oxyptilus praedator</i> ..	217
<i>vaughani</i> ..	217
<i>Oziotelphusa</i> ..	260

P

<i>Pachnephorus bretinghami</i> ..	212
<i>Patria kanaraensis</i> ..	210
<i>Pagrus spinifer</i> ..	131
<i>Palaemon</i> 277—280, 282, 287, 293, 296	
<i>alcocki</i> ..	277, 291, 293
<i>altifrons</i> ..	296
<i>brevimanus</i> ..	277
<i>carcinus</i> 277, 281, 283, 285, 287, 295	
<i>coromandelianus</i> ..	277
<i>danae</i> ..	283, 284
<i>dolichodactylus</i> 280, 300, 301	
† <i>dubius</i> 279, 280, 300, 301	
<i>idae</i> 278, 279, 285—287, 289—292	
<i>lamarrei</i> ..	301, 302
<i>lanceifrons</i> ..	287, 288
<i>lar</i> ..	290
<i>malcolmsonii</i> 279, 280, 283—285, 287, 295	
<i>mossambicus</i> ..	291
<i>multidens</i> ..	277
† <i>nobilis</i> ..	295
<i>petersii</i> ..	300
<i>potiuna</i> ..	302
<i>rudis</i> ..	277, 278, 280, 291, 293, 295
<i>scabriculus</i> 278—280, 296, 298, 300, 301	
† <i>sulcatus</i> ..	289, 292
<i>sundaicus</i> ..	285, 287—289
<i>tranquebaricus</i> ..	277
<i>weberi</i> ..	284
† <i>Pandora perangusta</i> ..	120
<i>Pangasius buchani</i> ..	140
<i>Paracryptops</i> ..	166
<i>weberi</i> ..	166, 170
† <i>Paradaksha</i> ..	327
† <i>meeki</i> ..	327
<i>Paranais</i> ..	65
<i>littoralis</i> ..	65
<i>Parapalaemon</i> ..	278
<i>Parapotamon</i> ..	257, 258
<i>endymion</i> ..	258
<i>spinescens</i> ..	258
<i>Paratella</i> ..	333
<i>amata</i> ..	333

	Page		Page
Paratella decolor ..	333	†Phyllyphanta albidosparsa ..	329
intacta ..	333	producta ..	329
invasa ..	333	sinensis ..	329
iodipennis ..	333	Phyma ..	325
subcincta ..	333	divisa ..	327
umbrimargo ..	333, 334	optata ..	325
Paratelfhusa ..	253, 254, 260	‡Phymoides ..	326, 327
(Barytelfhusa) ..	260	†atromaculatus ..	327
blanfordi ..	259	†rubromaculatus ..	326, 327
(Globitelfhusa) ..	260	Physostomi ..	131, 135, 137
(Liotelfhusa) ..	260	Plagusia ..	134
(Oziotelfhusa) ..	260	bilineata ..	134
(Paratelfhusa) ..	259	marmorata ..	134
(Phricotelfhusa) ..	260	†obscura ..	132, 134
tridentata ..	255	Platycephalus insidiator ..	132
Paratelfhusinae ..	254, 255	Platydoris ..	250
Pavo cristatus ..	275	Platyptilia gonodactyla ..	217
muticus ..	275	Platytfelfhusa ..	253, 257, 258
“nigripennis” ..	275	Plectognathi ..	136
Pectinatella ..	41, 54, 56	†Plectotropis biggiei ..	33
burmanica ..	56	ptychostyla ..	33
carteri ..	37, 55	Pleurobranchaea ..	247
davenporti ..	55	morula ..	247
gelatinosa ..	56	Pleurobranchus ..	247
magnifica ..	56	Pleuronectidae ..	130, 132
Pelopatides ..	95	Pleurophyllidia ..	247
confundens ..	95	Plumatella ..	37, 40—42, 53, 54
†dissidens ..	89, 94, 95	allmani ..	43, 48, 49
gelatinosus ..	95	var. diffusa ..	42
mammillatus ..	95	var. dumortieri ..	42
mollis ..	95	bombayensis ..	43, 50—52
verrucosus ..	100	coralloides ..	42, 45, 46, 48
Penaeus ..	277	diffusa ..	48, 49
Pentatomidae ..	313	dumortieri ..	48, 49
Percidae ..	131, 135, 138	elegans ..	49
†Periacma ? mnemonica ..	224	emarginata ..	37, 42, 43, 47—50
Pericoma ..	143, 144	var. javanica ..	50
Periophthalmus koelreuteri ..	132	fruticosa ..	42—46, 48
Periplaneta americana ..	201	fungosa ..	44
Peritelfhusa ..	253, 259	javanica ..	37, 42, 50, (?) 199
Peronea divisana ..	218	philippinensis ..	37, 50—52
Phalonia manniana ..	217	polymorpha ..	44
Phaloniadae ..	217	var. caespi-	
Phasianus colchicus ? ..	270	tosa ..	49
elegans ..	271	var. fungosa ..	44, 45
principalis komarowi ..	270	princeps var. emargin-	
principalis ..	270	ata ..	47, 48
shawi ..	270	var. fruticosa ..	45,
soemmerringi scintillans ..	271	46	
torquatus ..	271	var. muscosa ..	48
Phlebotominae ..	141, 142	punctata ..	42—44, 52, 53
Phlebotomus ..	143	var. densa ..	52, 53
Phloeinae ..	313	var. prostrata ..	52,
Phricotelfhusa ..	260	53	
gageii ..	260	repens ..	37, 43—46, 45, 49, 52
Phromnia ..	321	var. fungosa ..	44, 45,
flaccida ..	321	48	
floccosa ..	321	stricta ..	37, 45, 46
hamifera ..	321	tanganyikae ..	50, 51
montivaga ..	321	Plumatellidae ..	38, 39
pallida ..	321	Plumatellinae ..	38—40
parmata ..	321	Plumularia ..	14
rubeszens ..	321	campanula var. ..	15
Phycodes minor ..	226	catharina ..	14
Phylactolaemata ..	37—57	var. ..	15
Phyllidiidae ..	247		
Phyllyphanta ..	329, 330		

I. THE HYDROIDS OF THE INDIAN MUSEUM.

I.—THE DEEP-SEA COLLECTION.

By JAMES RITCHIE, M.A., B.Sc., *Natural History Department,
The Royal Scottish Museum.*

HYDROIDACEA

ERRATA.

Page 47, line 23. For "defected" read "defective."
,, 51, ,, 4. For "vertical" read "horizontal."

Along with the deep water species I have recorded a few specimens, chiefly from the neighbourhood of the Andaman Islands, regarding which no indication as to the depth at which they were obtained was given. But it appeared more fitting, since they belong to the same series of collections as the deep Andaman specimens, to consider them here rather than with the shallow water forms.

GENERAL NOTES ON THE COLLECTION.

Morphological.—Under this head little of special interest has to be recorded. I must note, however, the occurrence, in the only species of *Aglaophenia* found in the collection, of a peculiar and distinctive gonosome. This appears to be a modified type of corbula in which the protective leaflets, which are arranged in two tiers, bristle outwards from the body of the gonosome, while the gonangia are covered in and protected by delicate plates of chitin (see p. 16, pl. iv, fig. 7).

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I.—THE DEEP-SEA COLLECTION.

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The Royal Scottish Museum.*

INTRODUCTORY.

This paper contains a first instalment of the description of the extensive collection of Indo-Malayan Hydroids in the Indian Museum, Calcutta. To the Trustees of the Museum, represented by Dr. Nelson Annandale, Superintendent of the Museum, I desire to tender my thanks for his kindness in entrusting to me the identification of the collection.

Notwithstanding the unadvisedness of adopting a bathymetrical line of demarcation in dealing with so mobile a group as the Hydroida, in which many species occur at exceedingly variable depths, this instalment confines itself to those forms which have been found in the deeper waters of the Indian seas, and for these reasons: Few littoral specimens were present in the collections received from the Indian Museum, and it is deemed better to leave over the description of such forms until additional shore and estuarine collecting—undertaken by Dr. Annandale—shall have made this section of the collection more representative. On the other hand the deep-sea collection seems to be already fairly complete.

Along with the deep water species I have recorded a few specimens, chiefly from the neighbourhood of the Andaman Islands, regarding which no indication as to the depth at which they were obtained was given. But it appeared more fitting, since they belong to the same series of collections as the deep Andaman specimens, to consider them here rather than with the shallow water forms.

GENERAL NOTES ON THE COLLECTION.

Morphological.—Under this head little of special interest has to be recorded. I must note, however, the occurrence, in the only species of *Aglaophenia* found in the collection, of a peculiar and distinctive gonosome. This appears to be a modified type of corbula in which the protective leaflets, which are arranged in two tiers, bristle outwards from the body of the gonosome, while the gonangia are covered in and protected by delicate plates of chitin (see p. 16, pl. iv, fig. 7).

Notice has been taken of the more patent minimal variations which occur in the various forms, in the hope that the more stable defining of species may be thus forwarded.

In describing the parts of the Plumularidæ I have adopted in addition to the general term 'nematophore,' originally used to signify the organ as a whole, the Hincksian names sarcotheca and sarcostyle to differentiate the chitinous protection from its fleshy content. Since 'nematophore' has been and still is used in the wide sense indicated above, it seems to me impracticable to restrict its meaning to the perisarc of the organ only, as advocated by Nutting (1900, p. 13), in spite of the fact that it has been loosely used in this way by systematists. There is the less reason to regret the impossibility, on account of the inappropriateness of the name as applied to a chitinous protection. Nor does it seem wise to complicate the terminology of the subject by the introduction of such terms as nematotheca and dactylothèque for a portion already sufficiently and excellently designated sarcotheca.

Distribution.—From the bathymetrical point of view the collection is interesting as indicating for the first time the aspect of the Hydroid fauna of the deeper Indian waters. A Sertularian and an epizoidic Campanularian share the honour of having been dredged at the greatest depth, 1,343 fathoms, from beyond which exceedingly few Hydroids have ever been obtained. As they have already been recognised in shallow water—the former, *Idia pristis*, from 5 fathoms (Jäderholm, 1903) to 38 fathoms (Borradale, 1905), the latter, *Campanularia corrugata*, from 7 fathoms (Thornely, 1904) to 40 fathoms (Campenhausen, 1896)—their bathymetrical range is an extraordinarily wide one, comparable to that of *Sertularella tricuspidata*, which occurs from almost the shore to 1,375 fathoms (Bonnievie, 1899).

As to geographical distribution, the collection increases the recognised Hydroid fauna of Indian seas by eleven species and that of Malaysia by two. Four of these are described as new to science¹; while the remainder of the new Indian records show, in the main, extensions in the range of Malaysian or Australasian species. Of the total of twenty-four species and varieties recorded, four occurred in the Malay Archipelago; while of the twenty from Indian waters, twelve of the species have been previously found in the Australo-Malayan region.

So far as can be judged from a very limited collection, the affinity of the deep-sea Indian hydroid fauna is, as one would expect from general considerations of faunal distribution, most markedly with that of the South Pacific.

¹ A preliminary note on these new forms has appeared in the *Ann. Mag. Nat. Hist.* (8), vol. iii, pp. 524—528 (1909).

Table showing the species recorded in this paper, with their distribution.

	Indian Ocean.	Madagascar to Cape Colony.	Malaysia.	Australasia.	N. Pacific.	Atlantic.
Eudendridæ—						
<i>Eudendrium</i> sp. (p. 3)	×
Bougainvillidæ—						
<i>Bougainvillea</i> sp. (p. 4)	×
Campanularidæ—						
<i>Campanularia corrugata</i> , Thornely (p. 4)	×	×	×	×
„ (?) <i>spinulosa</i> , Bale (p. 5)	*	×	×	..
„ sp. (p. 6)	×
<i>Hebella crateroides</i> , Ritchie (p. 6) ..	*
<i>Thyroscyphus vitiensis</i> , M.-Turner. (p. 7)	×	×	×
Lafoëidæ—						
<i>Lafoëa gracillima</i> (Alder) (p. 8) ..	*	×	×	×
„ <i>serrata</i> , Clarke (p. 9)	×	×	×
Sertularidæ—						
<i>Cryptolaria operculata</i> , Nutting (p. 9)	*	..	×	..
<i>Sertularella polyzonias</i> , v. <i>cornuta</i> , Ritchie (p. 10) ..	*	×	..	×	..	×
<i>Idia pristis</i> , Lamx. (p. 11)	×	..	×	×	..	×
<i>Diphasia mutulata</i> (Busk) (p. 12) ..	×	×
„ <i>thornelyi</i> , Ritchie (p. 13) ..	*
Plumularidæ—						
<i>Antenella secundaria</i> (Linn.) (p. 14) ..	*	×	×	×	..	×
<i>Aglaophenia septata</i> , Ritchie (p. 15) ..	*
<i>Lytocarpus annandalei</i> , Ritchie (p. 17)	*
„ <i>pennarius</i> (Linn.) (p. 19)	*	..	×	..	×	..
„ <i>philippinus</i> (Kirchen) (p. 20) ..	×	..	×	×	..	×
„ <i>phæniceus</i> (Busk) (p. 21)	×	..	×	×	×	..
<i>Halicornaria balei</i> (M.-Turn.) (p. 22) ..	×
„ v. <i>flava</i> , Nutting (?) (p. 23)	*	×	..
„ <i>gracilicaulis</i> (Jäderh.) (p. 23) ..	*	×	×	..	×	..
„ <i>hians</i> , v. <i>profunda</i> , Ritchie (p. 24)	*	×

N.B.—(1) A * indicates a new record for region.

(2) Where varieties only are recorded the distribution of the species as a whole is shown.

SYSTEMATIC ACCOUNT OF THE COLLECTION.

GYMNOBLASTEA.

Family EUDENDRIDÆ.

Eudendrium, sp. indet.

A few small and dilapidated specimens little over 1 cm. high, with no trace of hydranths. While the trophosome might very

well be that of *E. ramosum* (Linn.), we prefer, considering the absence of the hydranths, to leave it unnamed.

LOCALITY: On *Epizoanthus* sp. from the Malay Archipelago; depth 160 fathoms.

Family BOUGAINVILLIDÆ.

Bougainvillea, sp. indet.

A single colony occurs in the collection, and as it is probably a young form (it is only 7 mm. high) it cannot be specifically identified. It agrees with *B. ramosa* (Van Beneden) in several points, for its hydrocaulus is fascicled at the base, is not simple, and has been attached by a delicate hydrorhiza, while the hydranths bear from 9 to 13 tentacles. No ringing is present on the hydranth-bearing branches, but a definite kink occurs just where they leave the stem. From *B. ramosa*, however, the specimen differs greatly in size and in the fact that the hypostome of the hydranth is flattened rather than sharply conical.

A single very immature gonosome arises from one of the branches.

LOCALITY: Growing on the type specimen of *Scalpellum sociabile*, Annandale, from Bali Straits (Java), Malay Archipelago; depth 120 fathoms.

CALYPTOBLASTEÆ.

Family CAMPANULARIDÆ.

Campanularia corrugata, Thornely.

Thornely, L. R., 1904, p. 114, pl. i, fig. 2.

Billard, A., 1907 (2), p. 341, fig. 1.

Many calyces of this species spring from stolons creeping on specimens of *Idia pristis*. In all respects they agree with Miss Thornely's description and figures, except that, like Dr. Billard's examples, they are of much smaller growth, and possess in some cases a more corrugated hydranthophore. In well-preserved specimens a very delicate partition exists beneath the base of the hydranth, separating the cavity of the hydrotheca from that of the stalk.

Detailed measurements show that these Indian specimens are on the whole somewhat smaller than those recorded from Madagascar and Natal (see references below):—

Hydranthophore, length	..	..	0.25—0.63 mm.
Hydrotheca, length	..	..	0.91—1.22 ,,
,, diameter	..	..	0.49—0.53 ,,

Considering the variations which occur in these Indian examples as regards the size and shape, the ringed or smooth condition of the hydrotheca, and the presence of corrugations on the peduncle, I am of opinion that the characters relied on by myself in distinguishing *C. mutabilis*, Ritchie (1907 (2), p. 504), from this

species are untrustworthy, and that the two forms are specifically identical. Nor is there any point by which *Lafoëa magna*, Warren (1908, p. 343), can be separated from Miss Thornely's species. These names therefore, *Lafoëa magna*, Warren, and *C. mutabilis*, Ritchie, must be regarded as synonyms of *C. corrugata*, Thornely.

LOCALITY: Climbing on *Idia pristis* obtained by the R.I.M.S. "Investigator," at Station 312, lat. $16^{\circ} 56' 15''$ N., long. $92^{\circ} 35' 00''$ E. (off Lower Burma); depth 1,343 fathoms.

Distribution.—Recorded from the Indian Ocean: Ceylon (Thornely, 1904), Madagascar (Billard, 1907 (2)), Natal (Warren, 1908); and from the tropical Atlantic: Cape Verde Islands (Ritchie, 1907 (2)).

C. corrugata has been found at other localities from which, however, it has not been recorded as such. Armstrong (1879, p. 101, pl. xi) figures what is undoubtedly a colony of this species climbing over *Halicornaria plumosa*, and he describes the hydrotheca as the gonosome of the Plumularian. His specimens were found in "30 to 40 fathoms, Cape Comorin, S. of India, and in 10 to 15 fathoms, off Cheduba Island, coast of Arrakan." Campenhausen (1896, pl. xv, fig. 3) figures, without mentioning, hydrothecæ of this species on an unidentified Plumularian (apparently *Halicornaria gracilicaulis* (Jäderholm)) which was found in the littoral zone off Ternate. This occurrence extends the distribution of *C. corrugata* into the South Pacific.

Campanularia (?) *spinulosa*, Bale.

Bale, W. M., 1888, p. 756, pl. xii, figs. 5—7.

Two minute colonies, each 6 mm. high, have been assigned to this species. The stem of one shows a trace of fasciculation of the type figured by Bale for this species, an offshoot from the base of one of the branches growing downwards along the original stem. The hydrothecæ are exceedingly delicate and have in most cases collapsed so completely that the character of the margin is altogether obscured. In the cases where the bicuspid teeth were visible they seemed to be somewhat less pointed than in Bale's figure. The pedicels taper slightly upwards and are generally annulated throughout, bearing from 6 to 16 rings; but sometimes a long pedicel occurs with rings only at top and bottom. The hydranth has about 14 long tentacles.

Measurements.

Hydrotheca, length	..	..	0.77—0.84 mm.
„ diameter	..	..	0.28 „
Stem, diameter of single tube	..	..	0.13 „

As it is impossible in the absence of the gonosome to determine with precision the generic position of this species, I have retained for it the name given it by Bale. It seems probable, however, that it is either an *Obelia* or a *Gonothyræa*, for its trophosome is scarcely distinguishable from that of gonosome-bearing specimens

from New Britain, recorded by Miss Thornely (1899, p. 454) as *Gonothyraea longicyatha*.

LOCALITY : Found growing on the type specimen of *Scalpellum sociabile*, Annandale, from Bali Straits (Java), Malay Archipelago ; depth 120 fathoms.

Distribution.—Bale's specimens were found at Port Jackson, East Australia ; Nutting has recorded the species from Maui, one of the Hawaiian Islands (Nutting, 1905, p. 943).

Campanularia, sp. indet.

A few specimens growing upon a type specimen of *Scalpellum squamuliferum* were in so poor condition that I have not ventured to name them. They are Campanularians with stems (up to 12 mm. high) which are generally unbranched, although occasionally smaller replicas of the main stem spring from it. The stem is topped by a hydrotheca with exceedingly delicate walls which have collapsed so thoroughly that nowhere was the margin visible. On this account the structure of the rim, an important diagnostic character, could not be observed.

The general structure of the recognisable portions of the specimens is similar to that of a gigantic *Clytia johnstoni*, Alder : stems with about 15 rings at the base, and about 3 below the hydrotheca, the median portions being smooth except where regeneration has occurred. Hydrothecæ similar to those of *Clytia johnstoni* in shape, and in the minute structure of the base, remainder unrecognisable. No gonosome is present.

Measurements.

Stem, diameter	..	..	0·11—0·17 mm.
Hydrotheca, depth, <i>circ</i>...	..	..	0·98—1·19 „
„ maximum diameter, <i>circ</i> .			0·70 „

LOCALITY : Growing on *Scalpellum squamuliferum*, Weltner, from the Andaman Islands ; depth 271 fathoms. Marine Survey collection. Reg. No. 1197/10.

Hebella crateroides,¹ Ritchie.

(Pl. iv, fig. 1.)

Ritchie, J., 1909 (2), p. 524.

This form occurs in abundance on specimens of *Lytocarpus phæniceus*. A creeping hydrorhiza meanders over the posterior portions of the stem and branches of the Plumularian, sending off here and there a hydrotheca or gonotheca. The hydrothecæ are small and colourless, often asymmetrical in shape, with firm walls, marked in some cases by exceedingly faint corrugations, and gracefully everted round the margin. The hydranthophore is not distinctly indicated, for the hydrotheca gradually diminishes in diameter from the margin until the hydrorhiza is reached, except for a slight bulging about the middle. In some cases (as in pl. iv,

¹ κρᾶτηρ = a cup.

fig. 1) a single joint traverses the stalk, but this is due to fracture and subsequent regeneration; in normal specimens no joint occurs, and only a delicate film separates the cavity of the hydrotheca from the common cavity of the colony. The hydranth has about 6 to 8 tentacles.

Gonosome.—The gonangia are borne on short and indefinite stalks, and are at least three times as large as a hydrotheca. They are roughly cylindrical in shape, and have walls circled by faint and irregular corrugations. In the earlier stages of development an opercular plate ("deckenplatte") at the end of the blastostyle, closes in the top of the gonangium, but, as development proceeds, this disappears and the perisarc folds outwards, forming a gracefully everted margin. The developing medusæ, three in number in each gonangium, are roughly spherical, but the state of preservation was so imperfect that details could not be observed. The manubrium is large, and four stout tentacles are present ere the medusa is set free.

Measurements.

Hydrotheca, length	.. .. .	0.36—0.39 mm.
„ diameter at mouth	.. .. .	0.18—0.21 „
Gonangium, length	.. .. .	1.01—1.23 „
„ maximum diameter	.. .. .	0.36—0.43 „

From *Hebella calcarata* (A. Agassiz), which it approaches, this species differs in its hydranth, which has only seven instead of about sixteen tentacles, and in its hydrotheca, which has neither the cylindrical shape nor the marked bulging towards the base characteristic of the other species, and which, moreover, shows no traces of a strong chitinous septum at the base. From *H. lata*, Pictet (1893, p. 40, pl. ii, figs. 34, 35), it is distinguished by having fewer tentacles, by its much smaller size, and by the more obconical shape and everted margin of its hydrotheca.

LOCALITY: Growing on *Lytocarpus phæniceus*, dredged 8 miles west of Interview Island, Andaman Islands, depth 270—45 fathoms.

Type in the Indian Museum, Calcutta.

Thyroscyphus viticensis, Marktanner-Turneretscher.

Markt-Turner., G., 1890, p. 210, pl. iii, fig. 10.

Two small fragments which appear to me to represent this species occurred with other odd colonies from the Andamans. They are only 12 mm. high, portions of young colonies, but even so they show considerable variation in the length and diameter of the internodes. In one fragment, which is strongly geniculate, they are from 1.5 to 1.9 mm. long, and 0.15 mm. in diameter; in the other, while the length remains similar, the diameter is 0.32 mm. The hydrothecæ measure from 0.98 to 1.12 mm. in height, and 0.66 mm. in diameter at the mouth. The hydranths, which are exceedingly dumpty when contracted, appear to have about 26 to 30 tentacles.

The colonies described by Miss Thornely (1904, p. 113) as young specimens of *Campanularia juncea* seem to me, as to Dr. Billard, indistinguishable from this species.

LOCALITY: Andaman Islands, 1899; 60 fathoms.

Distribution.—*Thyroscyphus vitiensis* is an Indo-Pacific species, recorded from the Malay Archipelago (Markt.-Turn., 1890), from various localities in the neighbourhood of Madagascar (Billard, 1907 (2)), from Ceylon (Thornely, 1904), and from the Andamans (present record).

Family LAFOEÏDÆ.

Lafoëa gracillima (Alder).

Alder, J., 1857, p. 39, pl. vi, figs. 5, 6; as *Campanularia gracillima*. Allman, J. G., 1888, p. 34, pl. xvi, figs. 2, 2a; as *Lafoëa fruticosa*. Bonnévie, C., 1899, p. 64, 65, pl. v, fig. 2a.

Three small colonies were found growing on the spine of a *Cidarid* Sea-Urchin. The colonies are less complex and less bushy than are normal specimens, and the largest is only 15 mm. high, without a single branch; but it was not to be expected that colonies placed on so movable a foundation should attain typical robustness of development. The compound stem is of the rhizocaulom type, and the structure of a hydrotheca is typical, a solitary twist separating it from the stem, while the upper surface is strongly convex and the lower, although it is considerably straighter than in British specimens, also tends to curve parallel to the upper profile. These characters make certain the identity of the specimens with *L. gracillima*, notwithstanding that the dimensions of the hydrothecæ are much greater, and the minute structure as a whole is more robust, than in typical examples of that species. In those respects the Indian examples approach a variety, *benthophila*, collected by the Scottish National Antarctic Expedition, south of the South Orkneys, at a depth of 1,775 fathoms (Ritchie, 1909 (1), p. 76); and since the present examples also have been dredged from deep water it may be that the unusual robustness in minute structure is correlated with the unusual depth at which the specimens existed.

For comparison the sizes of var. *benthophila* and of a typical form are given alongside those of the Indian specimens:—

	Indian Museum specimen.	Antarctic var. <i>benthophila</i> . ¹	North Sea typical specimen. ²
Hydrotheca, length including hydranthophore	0·87—0·95 mm.	0·87—1·01 mm.	0·57—0·76 mm.
Hydrotheca, diameter at mouth	0·20—0·24 „	0·21—0·25 „	0·11 „
Diameter of a single tube of stem	0·11 „	0·16 „	0·10 „

¹ Mentioned in the table in the *Supplementary Report on the Scotia Hydroids* as a “Coat’s Land specimen.” The locality, as shown by the bearings, is considerably nearer to the South Orkneys than to Coat’s Land.

² Specimen from lat. 58° 34’ N., long. 0° 47’ E., in my collection.

LOCALITY: Growing on the spine of a Cidarid Sea-Urchin dredged from Station 358 of the R.I.M.S. "Investigator," lat. $15^{\circ} 55' 30''$ N., long. $52^{\circ} 38' 30''$ E. (Arabian Sea, near the Gulf of Aden); depth 585 fathoms.

Distribution.—(See Hartlaub, 1905, p. 594.) A species of world-wide range recorded from the North Pacific (Marktanner-Turneretscher, 1890; Nutting, 1899; Torrey, 1902); the North Atlantic Ocean (Hincks, 1868, etc.); the South Atlantic Ocean (Allman, 1888; Hartlaub, 1905; Jäderholm, 1905; Ritchie, 1907 (1)); the Arctic Ocean (Bergh, 1887); the Antarctic Ocean (Ritchie, 1909 (1)); South Australia (Bale, 1884). The species has not hitherto been recorded from Indian seas.

Lajoëa serrata, Clarke.

Clarke, S. F., 1879, p. 242, pl. iv, fig. 25.

Hartlaub, C., 1905, p. 595, fig. Q².

Represented in the collection by only a few specimens which agree in dimensions with the typical examples recorded by Billard from the coasts of Spain.

Measurements.

Hydrotheca, length of adnate portion	..	0.22—0.27 mm.
" " free	..	0.25—0.29 "
" diameter at mouth	..	0.063—0.077 "

LOCALITY: Creeping on *Sertularella polyzonias* var. *cornuta*, from 8 miles west of Interview Island, Andaman Islands; depth 270—45 fathoms.

Distribution.—A widely distributed species recorded from the east and west sides of the North Atlantic (Billard, 1907 (1); Clarke, 1879); from the Straits of Magellan (Hartlaub, 1905); and from the Indian Ocean (Zanzibar, Billard, 1907; Gulf of Manaar, Thornely, 1904; Andamans, present record).

Family SERTULARIDÆ.

Cryptolaria operculata, Nutting.

Nutting, C. C., 1905, p. 947, pl. iii, fig. 4; pl. x, 12—14.

Colonies of this species much more complete than those found by Professor Nutting occur in the collection. Although now somewhat broken, the largest colony when pieced together reaches a height of about 20 cm. It has a thick fascicled stem, 3 mm. in diameter at the base, of a pale brown colour, and terminating in a flattened basal expansion. From the stem arise strongly fascicled, gnarled branches (2 mm. in diameter), which bear off-shoots to the fifth or sixth degree. Although they lie roughly in one plane, little regularity pervades the arrangement or structure of the

branches, and, especially in the older parts of the colony, anastomosis between branches, or even between two neighbouring colonies occasionally takes place.

As regards the characters of the hydrotheca there is little to be added to Nutting's description. If the expansion at the base of the polyp be taken as indicating the bottom of the hydrotheca, since no perisarc structure marks the boundary between the hydrotheca and the common cavity, then about half of the hydrotheca is adnate to the branch, and about half free, at least on those portions where fascicling has not obscured the relations of parts. The operculum is, as Nutting surmised, similar in structure to that in the genus *Stegopoma*.

The hydranths are large and fusiform, similar in shape to Hincks's figures of those of *Halecium halecinum* (Hincks, 1868, pl. 42, fig. b). They are crowned by about eleven tentacles and are moored to the hydrotheca by strands of cœnosarc projecting from a basal expansion.

No gonosome was observed.

Measurements.

Hydrotheca, length adnate	..	..	0.50 mm.
„ „ free	..	..	0.49—0.56 „
„ diameter	..	..	0.17—0.21 „

LOCALITY: Malay Archipelago; depth 160 fathoms. Marine Survey collection. Reg. No. 8416/6.

Distribution.—*C. operculata* has been recorded hitherto only from "between the islands of Molokai and Maui, 138 fathoms," Hawaiian Islands (Nutting).

It is of interest to note that dwelling within the tubes of very many of the stems, even those in which the polyps are quite fresh, having apparently been alive when the specimen was obtained, are minute tentacled polychæte worms.

Sertularella polyzonias (Linnæus), var. *cornuta*, Ritchie.

(Pl. iv, fig. 2.)

Ritchie, J., 1909 (2), p. 525.

From two localities come colonies which I record as a variety of *S. polyzonias*. Their habit differs considerably from the lax growths of var. *gracilis*, Kirchenpauer, which occur on the coasts of Britain, for the stem is thicker and more definite, and the branches alternate more regularly. There is nothing however to distinguish the minute characters of the hydrothecæ from those of some of the many forms of *S. polyzonias*, their shape approaching most closely, perhaps, that figured by Hartlaub (1900, Taf. v, fig. 5) from Juan Fernandez. On the whole, the facies of the trophosome approaches

that of var. *robusta*, Kirchenpauer (1884), from the Cape of Good Hope.

The gonangia are characteristic. While they have the elongate-ovate shape and the strong corrugations of typical specimens, they are surmounted by four stout spines lying cross-wise, in a plane at right angles to the long axis of the gonangium. This character has given its designation to the variety.

Measurements.

Hvdrotheca, length of adnate portion	..	0'25—0'39	mm.
„ „ free portion	..	0'25—0'28	„
„ „ greatest diameter	..	0'22—0'28	„
„ „ diameter at mouth	..	0'17—0'20	„
Gonangium, length	..	1'37	„
„ „ greatest diameter	..	0'59	„
„ „ length of " horns "	..	0'22	„

LOCALITIES: (a) Andaman Islands; depth 490 fathoms; Reg. No. 64/7; (b) 8 miles west of Interview Island, Andaman Islands; depth 270—45 fathoms.

Type in the Indian Museum, Calcutta.

Distribution.—World-wide, but although the species has been recorded from the Red Sea (Kirchenp., 1884), from off Australia (Bale, 1884), and from Natal (Warren, 1908), it has not hitherto been found in Indian seas.

Idia pristis, Lamouroux.

Lamouroux, J. V. F., 1816, p. 200, pl. v, fig. 5.

Allman, J. G., 1888, p. 85, pl. xxxix.

A clump of many colonies—the larger about 7 cm. high—alone represents this species. The clump is the centre of a life-association of much variety: about the base were corallines, and coral skeletons; intertwined with the hydroid stems were at least two species of Alcyonarians; while over the colonies themselves meander a creeping Polyzoon and a hydroid recorded above,—*Campanularia corrugata*.

My observations as to the structure of polyp and hydrocaulus confirm those of Billard (1907, p. 351), for, contrary to Allman's description (1888, p. 86), I can find no trace of an interior chamber containing a diverticulum of the base of the polyp.

LOCALITY: Collected by the R.I.M.S. "Investigator" at Station 312, lat. 16° 56' 15" N., long. 92° 35' 00" E., off Lower Burma; depth 1,343 fathoms.

Distribution.—The records of this species have been recently brought together by Billard (1907, p. 352). Its centre of distribution appears to be in the Indo-Pacific region, for it has been found on the east coast of Australia, among the East Indies, off the Malay Peninsula, and in the Indian Ocean. A solitary record—that

of the "Challenger"—from off Bahia, in Brazil, indicates its presence in the Atlantic Ocean.

Diphasia mutulata (Busk).

(Pl. iv, fig. 3.)

Busk, G., 1852, p. 391; as *Sertularia mutulata*.

Bale, W. M., 1884, p. 101, pl. ix, figs. 6—9.

A few small specimens of this species were growing on a sponge. They are only about 10 mm. in height and are unbranched, whereas Busk's type was 3 inches high and bore irregular branches; but the minute structure corresponds with Busk's rather meagre description. The colonies, which are of delicate texture, are faintly tinged with brown. The hydrothecæ are in pairs, sub-opposite on the proximal portion, but on the same level in the distal part of a colony. Occasionally too, nodes, though indistinguishable at the base of a specimen, are discernible towards its tip. The hydrothecæ are deep and narrow; their distal free portion projects at right angles to the stem, its length being equal to about $\frac{1}{3}$ that of the adnate portion. The aperture faces upwards and slightly outwards, is elliptical in shape, broader than deep, bounded on the adcauline side by a straight margin, on the abcauline by a gentle curve. An operculum is present, hinged to a thickening of perisarc on the free edge of the adcauline wall. Within the hydrotheca is a prominent intrathecal ridge, projecting from the mid portion of the abcauline wall and curving strongly upwards. The lateral portions of this partition can be traced for a considerable distance along the walls of the hydrotheca, but its general limit is strongly defined by a thickened edge.

No gonosome was present.

Measurements.

Hydrotheca, length of free portion ¹	..	0'15—0'21	mm.
„ „ adnate portion	..	0'45—0'52	„
„ diameter of free portion	..	0'20	„
„ „ adnate portion		0'10	„
„ breadth of aperture from			
side to side	..	0'27	„
Distance between hydrothecæ	..	0'08—0'14	„

LOCALITY : Growing on a sponge from the Andaman Islands, 1899; depth (?) 490 or 60 fathoms.

Distribution.—Previously recorded from Torres Straits (Busk, 1852); Port Molle (Bale, 1884); off Galle, off Negombo, and in the Gulf of Manaar (Thornely, 1904); Suez docks and Suez Bay (Thornely, 1908).

¹ Measured along adcauline wall.

Diphasia thornelyi,¹ Ritchie.

(Pl. iv, figs. 4, 5.)

Ritchie, J., 1909 (2), p. 525.

Several delicate, unbranched colonies, with non-fascicled stems were found growing about the "root"-masses of *Lytocarpus pennarius*. They are small (the largest only 16 mm. high), spring from a simple stolon, show no traces of nodes, and bear hydrothecæ from the base upwards. The hydrothecæ vary much in their position relative to one another. They are biserial and lie in the same plane, and although in most cases they are alternate or sub-alternate, rarely an opposite arrangement is simulated.

A hydrotheca is deep and narrow, with the inner edge adnate to the stem for practically its whole length, except for a short horizontal knobbed ledge upon which the adcauline operculum is hinged. The cavity of the hydrotheca is divided into two parts by a short upturned ridge which projects from the abcauline wall midway between the base and margin. Proximal to this hooked intrathecal ridge the wall of the hydrotheca suddenly becomes much thicker (up to 60 μ), and is continued thus till the next hydrotheca is reached. The outer wall of the distal half of the hydrotheca curves gently outwards and upwards, and almost parallel to the outer wall, and terminating at the base in a thickened ridge, runs the partition which separates the cavity of the hydrotheca from that of the stem. The margin is smooth and rimmed, a border being formed by a well-marked line which runs parallel to the lateral edges of the hydrotheca. The aperture, which faces somewhat towards the stem, forms an arc of a circle, its outer border being rounded, while its adcauline side, bounded by the horizontal ledge on which the operculum rests, is straight. The distal portion of the hydrotheca, as a whole, assumes the appearance of a bracket projecting from the stem. The operculum is a single, strong, adcauline disk, which rests on a thickened ledge.

Gonosome.—The gonothecæ arise from immediately beneath the hydrothecæ, and are without stalks. They are ovate in shape but are somewhat asymmetrical, a bulge occurring on the shoulder towards the stem. The aperture is cylindrical, placed on a short neck, and the distal half of the gonangium is ornamented with scattered but prominent spines.

Measurements.

Hydrotheca, length	..	..	..	0.38—0.45 mm.
„ breadth	..	..	..	0.11—0.14 „
„ diameter of aperture from				
side to side	..	..	..	0.21 „
Gonangium, length	..	..	..	0.64 „
„ maximum diameter	..	..	..	0.32 „

¹ This species has been named in honour of Miss Laura R. Thornely whose paper on the Hydroids collected by Professor W. A. Herdman off Ceylon has added much to our knowledge of the Indian members of the group.

A form of *D. mutulata* was figured by Miss Thornely (1904, pl. ii, figs. 6A, 6B, p. 118), and was described as having hydrothecæ which are "smaller and less prominent [than on other *D. mutulata* specimens] and sometimes sub-alternate, and the gonothecæ on these have only a few spines near the top and are of smaller size." This form appears to me to belong to the species described above. Miss Thornely's specimens were found in the neighbourhood of Ceylon.

LOCALITY: Growing on the root-like masses at the base of *Lytocarpus pennarius*, Andaman Islands. Collected by J. Wood-Mason.

Type in the Indian Museum, Calcutta.

Family PLUMULARIDÆ.

Antenella secundaria (Linnaeus).

Linnaeus, C., 1788-1793, p. 3854; as *Sertularia secundaria*.

Pictet, C., and Bedot, M., 1900, p. 27, pl. vi, fig. 7; as *Plumularia secundaria*.

Only a few small colonies of this species occur in the collection. The characteristic minute sarcotheca which lies in the angle behind the hydrotheca is clearly present; the architecture differs in no detail from that of Atlantic specimens of this well-known species.

No gonangia are present.

It is not without considerable hesitation that I have transferred this well-known species from *Plumularia* to Allman's genus, *Antenella*. But, while it seems absurd to place in distinct genera, forms the minute structures of which are so similar as are those of *Plumularia catharina* and *Antenella secundaria*, yet it is sufficiently clear that the simple hydroclade-stem is characteristic of a considerable number of species, and therefore as a matter of systematic convenience it appears reasonable that *Antenella* should be retained as a separate genus, or at least as a sub-genus of *Plumularia*, until the classification of the Eleutheroplean Plumularians has been placed on a basis more satisfactory than that which at present holds.

Recent synonyms.—I am unable to find any character in Dr. E. Warren's description and figures of *Antenella natalensis*, Warren (1908, p. 318), which could separate it from the Linnean species recorded above. *A. natalensis* is obviously a synonym of *A. secundaria*.

In 1904 Miss Thornely described from Indian seas specimens of *Antenella gracilis*, Allman (1877), which "resemble the branches of *M[onostæchas] quadridens* exactly" (p. 121). These specimens, through the kindness of Miss Thornely and Professor W. A. Herdman, I have been allowed to examine. They differ from *A. gracilis*, as described and figured by Allman, in possessing an exceedingly minute postcalycine sarcotheca, while in Allman's species the superior median sarcotheca not only does not lie exactly in the angle between hydrotheca and internode, but it is equal in size to

the other median sarcothecæ. The specimens are examples of *Antenella secundaria*, not of *A. gracilis*.

LOCALITY: Climbing over *Sertularella polyzonias* var. *cornuta*, from 8 miles west of Interview Island, Andaman Islands; depth 270—45 fathoms.

Distribution.—*A. secundaria* is a widely distributed though rather uncommon species, recorded from the Mediterranean Sea (Heller, 1868; Mark-Turner, 1890); from the Atlantic Ocean, southwards from the shores of Britain (Hincks, 1868, as *Plumularia catharina* var.), and the Bay of Biscay (Pictet and Bedot, 1900; Billard, 1907 (1)) to the Azores (Billard, 1907), Madeira (Jäderholm, 1903), the north-west coast of Africa, and the Cape Verde Islands (Billard, 1907 (1)). Outside the Atlantic area it has been found in Indo-Pacific seas, from Natal (Warren, 1908, as *A. natalensis*), Ceylon (Thornely, 1904, as *A. gracilis*), Andaman Islands (present record), the Moluccas (Pictet, 1893), from Bass' Strait and Williams-town in Australia (Busk, 1852, and Bale, 1884, as *Plumularia campanula* var.¹), and from Japan (Stechow, 1907 and 1909).

Aglaophenia septata,² Ritchie.

(Pl. iv, figs. 6, 7.)

Ritchie, J., 1909 (2), p. 526.

A single imperfect colony, 65 mm. high, with a straight, fascicled, unbranched stem, was obtained at a great depth near the Andamans. The anterior tube of the fascicle is alone divided into internodes, which are separated by faint nodes, are of uniform lengths, and bear each a process upon which a hydroclade is set.

The hydroclades are biserial, lying in two planes which meet at an acute angle on the anterior side of the stem. They are alternate, project from the stem at an angle of 40° — 45° , and are about 8 mm. long (the longest being 11 mm.). The hydroclades are divided into regular thecate internodes each of which is partitioned by numerous strongly marked septa. Four septa generally spring from the posterior wall of the hydrotheca: a small one near the base of the supracalycine sarcothecæ, two from the middle of the hydrotheca, and the fourth from a postero-basal position. In addition, three project from the anterior wall of the internode proximal to the hydrotheca: of these the distal is very characteristic for it is tilted upwards, and, as in *Lytocarpus annandalei* of this report, traverses the base of the median sarcotheca, cutting off its cavity from that of the internode, but for a hole which allows of the passage of the cœnosarc.

The hydrothecæ are rather distant, almost triangular in lateral aspect, very narrow at their base, and widening greatly towards

¹ The identification of *P. campanula* var. with the above species is due to the researches of Dr. Billard who has examined Busk's type specimens in the British Museum (Billard, 1909).

² *Septata*—referring to the specific characters shown by the number and arrangement of the internodal septa.

the top. The margin has a prominent anterior tooth flanked by four distinct sinuations on each side. No intrathecal ridge exists, but the posterior wall bends inwards forming a rectangular bracket just above the base of the hydrotheca. The supracalycine sarcothecæ are large, almost cylindrical in shape, with a wide aperture, and an internal ridge projecting from a fold in their posterior wall. They slightly overtop the margin of the hydrotheca. The mesial sarcotheca is short, only about two-fifths the length of the anterior profile of the hydrotheca, to which it is altogether adnate except for a spout-like tip. Its cavity is interrupted by two processes: a button of chitin projects into it from the wall of the hydrotheca a short distance before the sarcotheca becomes free, and a septum, already described in connection with the internodal ridges, traverses its proximal end.

Three cauline sarcothecæ occur on each stem internode. Two of these are large, resembling the mesial sarcotheca in shape, and have a posterior internal ridge: the first lies on the anterior and near the proximal end of the internode, the other lies on that side of the hydroclade-bearing process which faces the centre of the stem, while the third sarcotheca is a mere perforation with slightly raised lips on the anterior of the process itself.

Gonosome.—Attached to the colony itself there occurred no reproductive body, but, entangled amongst the fibres at its base, a kind of corbula was found. This, in all probability, was really part of the colony, for no other Plumularian was contained in the same bottle, nor, in fact, were other Plumularians dredged at the same station. I shall describe it here on the supposition that gonosome and trophosome are one, a supposition which the similarity of their minute structures makes a virtual certainty.

The main body of this peculiar type of corbula consists of a hollow cigar-shaped portion within which lie six spherical reproductive masses in varying stages of development. Along the sides of this cylinder run two tiers of protective leaflets. Both the rows in the lower tier contain about 10 narrow, tubular leaflets armed with up to 16 or 18 nematophores, arranged biserially. In the two higher rows 8 or 9 leaflets are present, but they are more strongly developed and more irregular in shape than the others, frequently broadening out into leaf-like form. They, too, bear marginal nematophores but the biserial arrangement is less definite and the position of the sarcothecæ less regular. In structure the sarcothecæ correspond exactly to those which occur on the stem internodes.

All the leaflets stand away from the gonangia-bearing cylinder, and all are recurved, those of the upper tier more markedly than those of the lower. The lower surface of the cylinder, that is, the part corresponding to the keel of a typical corbula, bears longitudinal chitinous ridges—prolongations of the bases of the lower leaflets. On the upper side the gonangia are protected by delicate plates of chitin, some of which arise between the bases of the leaflets of the upper tier and bend inwards over the gonangia, while others

project from chitinous ridges stretching across the top of the cylinder from the bases of the leaflets.

Measurements.

Tube of fascicle, diameter	..	..	0'21—0'27 mm.
Stem internode, length	..	..	0'55—0'63 „
„ „ diameter	..	..	0'17—0'18 „
Hydroclade internode, length	..	..	0'63—0'64 „
Hydrotheca, depth	..	..	0'39—0'43 „
„ „ diameter at mouth	..	..	0'25—0'28 „
“Corbula,” length	..	..	4 „
„ „ greatest diameter	..	..	0'59 „

LOCALITY: Andaman Islands; depth 490 fathoms. Reg. No. 64/7.

Type in the Indian Museum, Calcutta.

While the general aspect of this species approaches that of *Thecocarpus*, I have placed it in the genus *Aglaophenia* on account of the gonosome, the protecting portions of which form a structure resembling a complex, open corbula, from the bases of the leaflets of which hydrothecæ are absent.

By the gonosome and by the shape and positions of the internodal septa in the hydroclades, together with the shape of the hydrotheca, this species may be distinguished from the other members of the genus.

Lytocarpus annandalei,¹ Ritchie.

(Pl. iv, figs. 8—10.)

Ritchie, J., 1909 (2), p. 527.

This species is formed for a single colony obtained at one of the deepest stations from which the “Investigator” obtained Hydroids. The colony, which is of a very dark brown colour, is unbranched, 63 mm. in height, with a rigid stem which is fascicled for its whole length, and is traversed by several pale constrictions slanting from behind downwards and forwards—such as occur in the species of *Thecocarpus*. Only the anterior tube, which does not possess nodes, bears hydroclades. These rest upon a short process from the stem, are close-set (separated by 0'5 mm.), alternate, and are divided into regular thecate internodes.

The hydrothecæ are closely approximated, deep, and rudely ovate in outline. Their aperture faces upwards and outwards, at an angle of about 45° with the stem; their profile is convex in the lower half, concave in the upper, while their margin bears a single prominent anterior tooth, and on each side four sinuations, of which

¹ I have pleasure in naming this species after Dr. Nelson Annandale, Superintendent of the Indian Museum, whose enthusiasm has done much for the advancement of our knowledge of the Invertebrate Zoology of India.

those second from the anterior tooth are somewhat larger than the others. The mesial sarcotheca is large, adnate for more than half the height of the hydrotheca, but with a scoop-shaped extremity free. The supracalcine sarcothecæ are very large, reach just above the margin of the hydrotheca, and possess a huge aperture. They are cylindrical in shape but for a constriction about midway, which is associated with an internal ridge traversing part of their cavity from the posterior wall.

The intrathecal ridge is little evident. Where present it is short, and projects into the lumen of the hydrotheca from a knob of chitin which terminates an angular in-bending of the posterior wall, situated a short distance above the floor of the cavity. The bases of the two sides of the angle are marked by well-defined ridges projecting from the posterior of the hydrotheca into the cavity of the internode, while a third posterior ridge arises just above the bases of the supracalcine sarcothecæ. Another shorter ridge projects backwards into the proximal portion of the internode from its anterior wall. Two important and characteristic chitinous thickenings are associated with the mesial nematophore: one is a simple knob, projecting forwards from the hydrotheca wall into the nematophore cavity near its mid point, the other is a sinuous septum traversing the base of the sarcotheca and isolating its cavity from that of the internode, except for a small opening through which the sarcostyle passes. Occasionally from the convex surface of this hook-like septum a small chitinous ridge projects backwards (see lower hydrotheca, pl. iv, fig. 9).

Two large scoop-shaped sarcothecæ lie on the hydroclade-bearing tube at the base of each hydroclade, one proximal to the process on which the hydroclade rests, the other supero-lateral, on the side of the process which faces inwards. The process itself bears a small, anterior, tubular sarcotheca.

Gonosome.—A few structures, apparently phylactocarps, are present, although unfortunately they are immature, or have lost their gonangia. They replace hydroclades on the lower portion of the stem, and are obviously morphological modifications of these, for they are divided into internodes each of which bears three regularly-arranged, scoop-shaped sarcothecæ—one median and proximal, the others lateral and distal, in a pair (pl. iv, fig. 10). Each internode corresponds to a thecate internode, without the hydrotheca. No hydrotheca occurs on the proximal internode of the phylactocarp. No gonangia are present, but, as in other species, they no doubt assume the positions of the missing hydrothecæ.

Measurements.

Hydroclade-bearing tube, diameter ..	0·21 mm.
Hydrocladial internode, length ..	0·48 „
Hydrotheca, depth	0·35 „
„ diameter at mouth ..	0·21 „
Phylactocarp, length of internodes ..	0·27 „

LOCALITY: R.I.M.S. "Investigator" Station 241, lat. $10^{\circ} 12' N.$, long. $92^{\circ} 20' 30'' E.$, between the Andaman and Nicobar Islands; depth 606 fathoms.

This is a very well-defined species, easily distinguished by the peculiar arrangement of its internodal ridges, by its large sarcothecæ, and by the sinuous margin of its hydrothecæ.

Type in the Indian Museum, Calcutta.

Lytocarpus pennarius (Linnæus).

(Pl. iv, fig. 11.)

Linnæus, C., 1758, p. 813; as *Sertularia pennaria*.

Allman, J. G., 1883, p. 42, pl. xiv; as *L. secundus*, Kirchenpauer.¹

This species is represented by a solitary much-weathered colony 56 cm. long, with a large basal mass of matted rhizoids; and by a few unattached branches. While the specimens agree with Allman's description, the following additional observations have been made. The hydroclades spring alternately from the anterior tube of the fascicle, and sometimes reach a length of 18 mm., three times the recorded length of those in the "Challenger" collection. The hydroclade-bearing process is accompanied by three large, scoop-shaped sarcothecæ, two of which are anterior—one on the process, the other proximal to it—while the third lies on the inner side of the angle between process and stem.

The hydrothecæ agree closely with the description of Marktanner-Turneretscher (1890, p. 273). The margin bears a prominent anterior tooth, and about four indefinite sinuations on each side. The intrathecal ridge is short, slants upwards, and often terminates in a prominent knob, while the internodal ridges are much more insignificant than those in Allman's figures. The mesial sarcotheca is adnate for little more than half the height of the hydrotheca and a connection exists between the distal portion of its cavity and that of the hydrotheca. The supracalycine sarcothecæ are asymmetrical, that on the side of the hydrotheca facing inwards towards the centre of the stem being very large and bowl-shaped, while the other has a diameter scarcely half that of its fellow (pl. iv, fig. 11). This difference may in part account for the discrepancy between the sizes of the sarcothecæ as figured by Kirchenpauer (1872) and by Allman, the latter having figured the hydrotheca from the stem side, the former from the opposite. Notwithstanding, however, the hydrothecæ of our specimens, as did those of Marktanner-Turneretscher, agree more closely with Kirchenpauer's diagnosis of *Aglaophenia crispata* than with that of *A. secunda*, to which Allman referred his specimens.

¹ The identity of the "Challenger" specimens with the Linnean species has been established by Billard (1908, p. 3) after comparison of the former with the Linnean type specimen in the British Museum.

A few branches of a specimen also occur in the collection in an unlabelled bottle. The hydrothecæ of these differ from those described above in being slightly more closely approximated, in possessing more distinct internodal and intrathecal ridges, larger cauline sarcothecæ, a longer mesial sarcotheca jutting out more strongly from the hydrotheca, and a margin rising into a broad lobe on each side. They differ also somewhat in size,—see table below. The branches bear phylactocarps with sometimes as many as 14 nematoclasts. The gonangia spring from near the bases of the nematoclasts and are broadly ovate.

Measurements.

	Andamans specimen.	Unlabelled fragments.
Hydroclade internodes, length ..	0.28 mm.	0.22 mm.
Hydrotheca, depth	0.27 „	0.22 „
„ diameter at mouth ..	0.14 „	0.13 „
Gonangium, length .. ..	..	0.64 „
„ greatest diameter ..	..	0.49 „

LOCALITY: Andaman Islands (collected by J. Wood-Mason, Marine Survey).

Distribution.—A distinctively Indo-Pacific species; recorded from the South Sea, China Sea, Pelew Islands, by Kirchenpauer (1872); from the Philippine Islands by Allman (*loc. cit.*), from Singapore by Marktanner-Turneretscher (*loc. cit.*), and now from Indian waters.

Lytocarpus philippinus (Kirchenpauer).

Kirchenpauer, G. H., 1872, pp. 29, 45, pls. i, ii, vii, fig. 26; as

Aglaophenia philippina.

Nutting, C. C., 1900, p. 122, pl. xxxi, figs. 4—7.

A specimen in fragmentary condition represents this species. The minute structures are altogether similar to those of previous descriptions, but there is considerable variation in insignificant details. Thus while the lateral margin is, more generally perhaps, a single large lobe, as in Marktanner-Turneretscher's figure of a specimen from the Red Sea (1890, pl. vi, fig. 15), sometimes it is divided into two distinct waves as in a Madagascar specimen figured by Billard (1907, fig. 18, p. 377). There are also considerable differences in the size of the embayment which separates the anterior tooth of the hydrotheca from the median sarcotheca.

Measurements.

Hydrocladial internode, length	0.27 mm.
Hydrotheca, width of lower portion ..	0.10—0.13 „
„ „ „ mouth	0.13 „
Mesial sarcotheca, length	0.27 „
„ „ „ of free portion	0.08 „
Supracalcine sarcotheca, length	0.17 „

LOCALITY: Karachi. Specimen from Karachi Museum.
Reg. No. 8210/9.

Distribution.—The geographical range of this species is extraordinarily wide for a form so large—one, therefore, unlikely to be transported readily from one locality to another far distant. It has been found in the South Pacific Ocean, amongst the Society Islands (Tahiti; Jäderholm, 1903). Thence it spreads along the east coast of Australia (Pt. Stephens, Pt. Denison, Moreton Bay; Bale, 1884, 1888) through Torres Straits (Kirkpatrick, 1890) to the East Indies (Pictet, 1893; Weltner, 1900) and South China Sea (Kirchenpauer, 1872).

In the Indian Ocean it has occurred off Karachi (Jäderholm, *l. c.*; and present record), and off the African coast in the neighbourhood of Madagascar (Billard, 1907 (2)). Ranging thence through the Red Sea (Mark.-Turner, 1890; Thornely, 1908) and the Mediterranean (Mark.-Turn., *l. c.*) it finally makes its appearance in the Atlantic, in the northern portion of which it has been recorded from Panama, Jamaica (Nutting, 1900), and Bermuda Islands (Congdon, 1907), and in the southern from Bahia (Nutting, *l. c.*).

Lytocarpus phæniceus (Busk).

Busk, G., 1852, vol. i, p. 398; as *Plumularia phænicea*.

Bale, W. M., 1884, p. 159, pl. xv, figs. 1—5; pl. xvii, figs. 1—4; pl. xix, fig. 31; as *Aglaophenia phænicea*.

A magnificent example of this species, 19 cm. high, with a spread of 10 cm., was obtained in deep water off Interview Island. The stalk is expanded at the base, and for 10 cm. upwards is destitute of branches, but, beyond this, luxuriant growth occurs. The macroscopic and microscopic structures agree admirably with previous descriptions, while of the many forms assumed by this exceedingly variable species the hydrothecæ of the specimens before me approach most closely those figured by Bale (1884, pl. xv, fig. 1) from specimens originally described by Busk from Torres Strait. They differ, however, in having less pronounced internodal septa, and in having the median sarcotheca tilted further upwards, this latter feature having been singled out by Marktanner-Turneretscher (1890, p. 276) in specimens from the Indian Ocean. A very evident second aperture is present on the superior interior surface of the lateral sarcothecæ.

Measurements.

Hydrocladial internode, length	..	0.25 mm.
Hydrotheca, diameter at mouth ¹	..	0.11 ,,
Median nematophores, length	..	0.15—0.18 ,,

LOCALITY: Eight miles west of Interview Island, Andaman Islands; depth 270—45 fathoms.

Distribution.—An Indo-Pacific species, which has been recorded from (1) Northern Pacific Ocean (Japan; Mark-Turn., 1890, Stechow, 1907 and 1909: Hawaiian Islands; Nutting, 1905); (2) China Sea (Amoy; Mark-Turn., *l.c.*); (3) East Coast of Australia (Port Denison; Bale, 1884); (4) North Coast of Australia (Port Darwin; Bale, *l.c.*: Torres Strait; Busk, 1852, Kirkpatrick, 1890); (5) East Indies (? Singapore; Kirchenpauer, 1872, as *Aglaophenia rostrata*); (6) Indian Seas (Mark-Turn., *l.c.*: Ceylon, 7—10 fms.; Thornely, 1904: Andaman Islands, present record).

Halicornaria balei (Marktanner-Turneretscher).

(Pl. iv, fig. 12, var.)

Marktanner-Turneretscher, G., 1890, p. 272, pl. vii, figs. 19, 20; as *Aglaophenia balei*.

A very few fragmentary colonies of this species were found projecting from a sponge. One agrees closely with the original description, but it is a fragment only 13 mm. in height, and from the delicacy of its structures appears to be a young specimen. Few differences, and these of no specific value in a genus where considerable variation is the rule, distinguish our specimens from the Red Sea examples. Thus the median lobe of the hydrotheca is less long and less pointed, and occasionally a second indistinct lobe appears on the margin; the median sarcotheca is somewhat longer, reaching clear of the edge of the hydrotheca; the hydrotheca is less markedly tilted forward; and in our specimens the opening at the base of the hydrotheca, through which the cœnosarc passed, is bordered by sharp chitinous spines, projecting into the hydrotheca cavity, which in profile give a pectinated appearance to the base of the cup. Probably the basal pecten was overlooked by Marktanner-Turneretscher, as it is difficult to be distinguished until the cœnosarc has been removed. The upper margin of the intrathecal ridge, viewed from in front, is seen to be rudely pectinated.

Although the gonosome is absent, the characters of the trophosome warrant the transference of this species from *Aglaophenia* to the genus *Halicornaria*. It is closely related to *H. hians*, Busk, 1852, from which it is to be distinguished by the strong convexity of its median sarcotheca (apparently a constant character), by its deeper hydrotheca, and by the position of the intrathecal ridge

¹ Measured in the direction of the hydrocladial axis.

which is situated at a greater distance from the base of the hydrotheca.

Measurements of parts are placed, for the sake of comparison, alongside those of the variety recorded below.

LOCALITY: Andamans, 1899; 60 fathoms.

H. balei, var. *flava*, Nutting (?).

(Pl. iv, fig. 12.)

Nutting, C. C., 1905, p. 955, pl. xiii, figs. 11, 12, as *Halicornaria flava*.

The remaining fragments of this species belong to colonies more robust in build, but with similar minute characters. Variations in the number and prominence of the lateral lobes occur here also, the large lateral lobe being sometimes accompanied by a smaller. The variety differs from the type however with regard to the compression of its hydrothecæ, for in the former they are so closely set that the lower part of the mesial sarcotheca of one depresses the upper margin of the hydrotheca immediately below it.

I am unable to find characters sufficient to separate Professor Nutting's *Halicornaria flava* from the compressed variety of *H. balei*, a species which, since he considered the chitinous projection within the mesial sarcotheca to be unique for the genus, Nutting had apparently overlooked. In our specimens, however, the stem nodes are irregular, bearing varying numbers of hydroclades, and in addition to the two sarcothecæ at the front of the base of each hydroclade, a third is situated behind.

Measurements.

	<i>F. typica.</i>	<i>V. flava.</i>
Stem, diameter	0·13 mm.	0·35 mm.
Hydroclade internodes, length	0·32 ,,	0·22--0·24 ,,
Hydrotheca, depth, base to topmost point	0·25 ,,	0·22 ,,
,, width, wing to wing	0·20 ,,	0·21 ,,

LOCALITY: Andamans, 1899; 60 fathoms.

Distribution.—The species has been recorded only from the Red Sea (Mark-Turn.); from the Bay of Bengal (present record) and from the Hawaiian Islands (Nutting, 1905).

Halicornaria gracilicaulis (Jäderholm).

Jäderholm, E., 1903, p. 299, pl. xiv, figs. 3, 4; as *Lytocarpus gracilicaulis*.

A graceful species represented by a few fragments protruding from a sponge. Although in an early stage of development the stem is already fascicled, and bears a single branch. The unjointed basal portion of the branch, to which Jäderholm refers, was indistinguishable, for although a length in our specimens is destitute of

hydrothecæ or hydroclades, it is divided by faint nodes into four internodes each of which bears a single median sarcotheca on its anterior surface.

The minute characters of the hydrothecæ agree exactly with those given by Jäderholm. It is worthy of note that in some of the hydrothecæ the internodal septa at the base of the supracalycine nematophores and opposite the intrathecal partition are much more strongly developed than Jäderholm's figure shows, while a third septum is occasionally visible stretching across the thecate internode close to its proximal end. One end of this septum rests on a knob of chitin projecting from the abcauline wall of the internode. In these details our specimens vary somewhat as did those described by Billard (1907 (2), p. 366).

The gonosome is not present but through its occurrence in specimens described by him Billard transferred the species from *Lytocarpus* to *Halicornaria*.

Measurements.

Hydroclade, length	.. ..	1—3	mm.
„ internode, length	.. ..	0.29—0.33	„
Hydrotheca, diameter	.. ..	0.91	„
„ „ of mouth, side			
„ „ to side	.. ..	0.11—0.13	„
„ „ „ back			
„ „ to front	.. ..	0.08—0.10	„

LOCALITY: Andaman Islands, 1899; 60 fathoms.

Distribution.—This species has seldom been recorded, but its distribution appears to be Indo-Pacific, for it has been found off South Japan (Jäderholm, 1903); at Ternate, in Oceania (figured by Campenhausen, 1897, pl. xv, fig. 3); on the south-east coast of Africa, at Macalunga and Mozambique (Billard, 1907 (2)); and the present record adds it to the fauna of India.

Halicornaria hians, Busk, var. *profunda*, Ritchie.

(Pl. iv, figs. 13, 14.)

Bale, W. M., 1884, p. 179, pl. xiii, fig. 6; pl. xvi, fig. 7, *H. hians*, typicus.

Ritchie, J., 1909 (2), p. 528.

The longest of the few colonies in the collection was only 4 cm. in height, with monosiphonic, unbranched stem, divided into internodes bearing generally two, occasionally three, alternate hydroclades. Each hydroclade is divided into thecate internodes twice as long as broad near the stem, but gradually becoming longer and more slender as they recede from it, until at the distal end of a hydroclade their length may be to their breadth as four to one.

The hydrothecæ are deep, with a margin divided on each side into three lobes, of which the superior and the median are the

sharpest and the most pronounced, and an aperture lying at an angle of about 30° with the axis of the hydroclade. A stout intrathecal ridge, running backwards to the middle of the lumen, where it ends in an upturned thickening, marks the position of an anterior fold in the hydrothecal wall. Small chitinous points surround the opening through which the hydranth connects with the common cœnosarc. The mesial sarcotheca is very variable, its early stage, as seen in young colonies or on the distal ends of some hydroclades, closely resembling that of *H. variabilis*, Nutting (1900, p. 127, pl. xxxiii, fig. 7), for it stops considerably short of the intrathecal ridge; while in its mature state it is adnate almost to the lip of the hydrotheca, projecting beyond the margin as a short free spout. Its most marked character in all stages is the concavity of its profile, and there is always present, more or less strongly developed, an internal chitinous projection almost on the level of the base of the hydrotheca. The supracalcine sarcothecæ are small, not reaching to the margin of the hydrotheca, almost oval in outline, with a solitary wide superior aperture. The cauline sarcothecæ are three in number, two on the stem anterior to the hydroclade and one posterior, almost in the angle above the hydroclade. In shape they resemble the supracalcine sarcothecæ—none are bilobed, nor have any two apertures.

Gonosome.—The gonangia, a funnel- or flask-like form of which has been described by Stechow (1907, p. 200; 1909, p. 102, pl. vi, fig. 17), are present in numbers. They are unprotected and are borne on very short stalks, one at the base of each hydroclade. In shape they are saucer-like, convex beneath, concave above, and appearing as perfect disks when viewed from the anterior of the colony.

Measurements.

	Mature colony.	Young colony.
Hydroclade internode, length	0.35—0.42 mm.	0.39—0.43 mm.
„ „ diameter at base	0.11—0.17 „	0.07—0.10 „
Hydrotheca, depth from base to highest teeth	0.28—0.29 „	0.25—0.27 „
„ „ diameter of lower portion	0.14—0.15 „	0.11—0.12 „
„ „ vertical diameter of mouth	0.20—0.21 „	0.17—0.18 „
Gonangium, diameter of disk. . . .	up to 0.38 „	..

LOCALITY: Andaman Islands, 1899; 60 fathoms.

Distribution.—Previously recorded from Torres Strait (Busk, 1852; Kirkpatrick, 1890).

Type of variety in the Indian Museum, Calcutta.

Remarks.—This variety is distinguished from the typical form as figured by Bale, by the greater length of the thecate internodes compared with their diameter, the greater depth and more erect posture of the hydrothecæ (to the former of which characters the name of the variety alludes), and the greater distance which separates the intrathecal septum from the base of the hydrotheca. The less

prominent nature of the marginal teeth, and the smaller size of the colonies are variations of little significance. There is a similarity between this variety and some of the stages of *H. variabilis*, Nutting (1900, p. 127), but the latter species possesses very large bilobed cauline sarcothecæ.

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II. NOTES ON FRESHWATER SPONGES.

By N. ANNANDALE, D.Sc., *Superintendent, Indian Museum.*

XII.—DESCRIPTION OF A NEW SPECIES FROM CAPE COMORIN.

The sponge described below was discovered by Mr. R. S. N. Pillay of the Trivandrum Museum in a tank near Cape Comorin, the southernmost point of the Indian Peninsula. I have examined several specimens.

Genus SPONGILLA.

Subgenus *Stratospongilla*, Annandale.

Spongilla ultima, sp. nov.

Sponge hard and strong, forming a thin layer on solid objects, of a pale green colour (dry); the oscula small but rendered conspicuous by the deep radiating furrows that surround them; external surface of the sponge rough but not spiny.

Skeleton forming a compact but somewhat irregular reticulation, in which the radiating fibres are not very much more distinct than the transverse ones; a considerable amount of almost colourless spongin present.

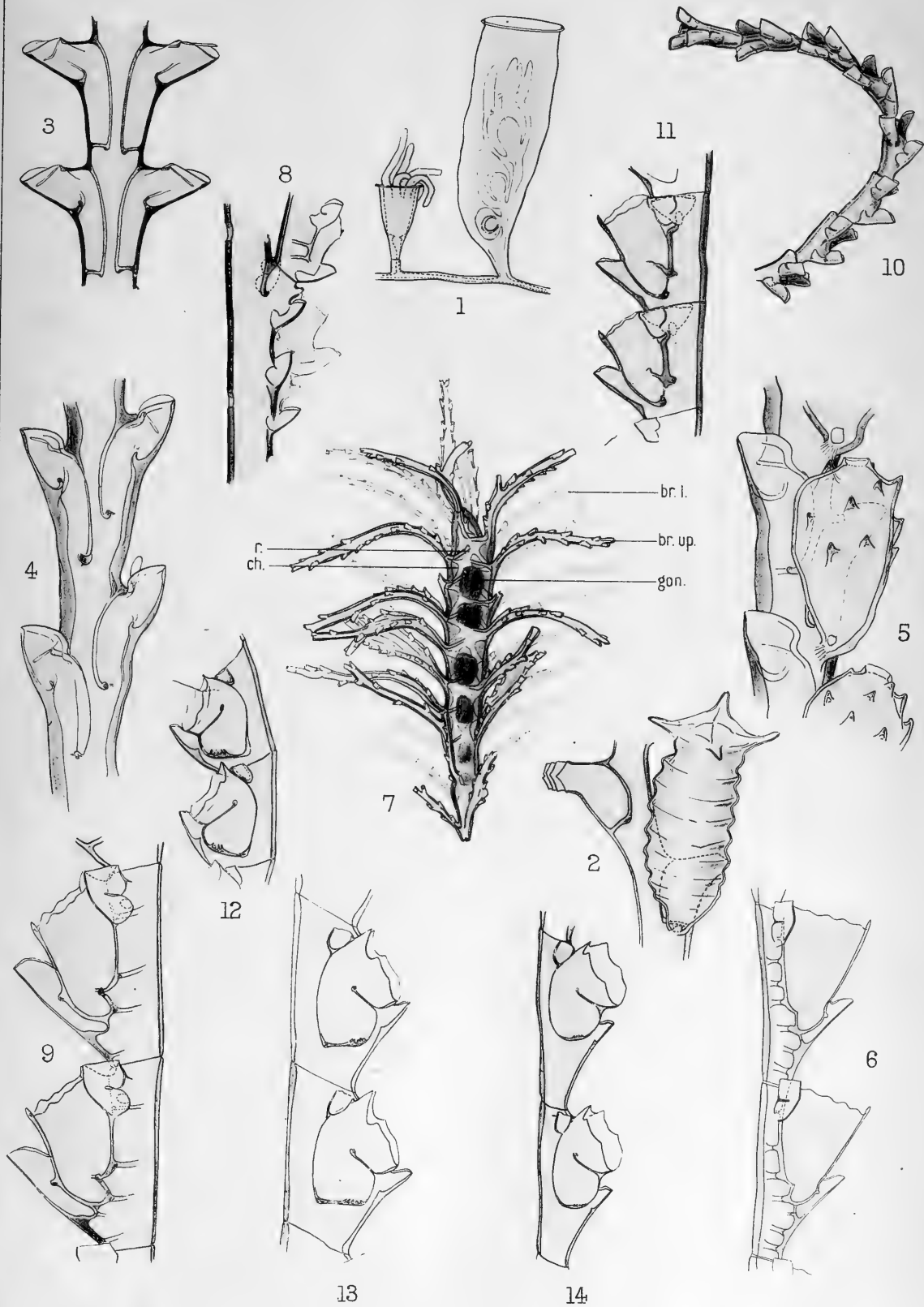
Spicules.—Skeleton spicules smooth, stout, amphioxious, as a rule straight or nearly straight, not infrequently inflated in the middle or otherwise irregular. No flesh spicules. Gemmule spicules variable in size, belonging to practically every type and exhibiting practically every abnormality possible in the genus, the majority being more or less sausage-shaped and having a roughened surface, but others being cruciform, spherical, subspherical, rosette-like, needle-like, bifid or even trifid at one extremity.

Gemmules adherent, spherical, large, each covered by two distinct layers of horizontal spicules; the outer layer intermixed with skeleton spicules and often containing relatively large siliceous spheres, a large proportion of the spicules being irregular in shape; the spicules of the inner layer much more regular and as a rule sausage-shaped. The outer layer is contained in a chitinous membrane, which spreads out over the base of the sponge. The foraminal tubules short and straight.

This sponge is allied to *S. bombayensis*, from which it is distinguished not only by the abnormal characters of its gemmule spicules and the absence of flesh spicules, but also by the form of its skeleton spicules and the structure of its skeleton.

EXPLANATION OF PLATE IV.

- FIG. 1.—*Hebella crateroides*, Ritchie. Portion of colony, showing both trophosome and gonosome, $\times 35$.
- „ 2.—*Sertularella polyzonias*, var. *cornuta*, Ritchie. Portion of branch with gonotheca, $\times 25$.
- „ 3.—*Diphasia mutulata* (Busk). Portion of stem with hydrothecæ, $\times 35$.
- „ 4.—*Diphasia thornelyi*, Ritchie. Portion of stem with hydrothecæ, front view, $\times 50$.
- „ 5.—*Diphasia thornelyi*. Portion of stem bearing gonangia, seen partly from the side, $\times 50$.
- „ 6.—*Aglaophenia septata*, Ritchie. Portion of hydroclade, $\times 45$.
- „ 7.—*Aglaophenia septata*. Gonosome, $\times 13$: *br.l.*, branchlet of lower tier; *br.up.*, branchlet of upper tier; *gon.*, gonangium; *r.*, ridge at base of upper leaflets projecting over gonangia; *ch.*, chitinous plate.
- „ 8.—*Lytocarpus annandalei*, Ritchie. Portion of stem showing bases of hydroclades, $\times 35$.
- „ 9.—*Lytocarpus annandalei*. Portion of hydroclade, $\times 60$.
- „ 10.—*Lytocarpus annandalei*. Phylactocarp, $\times 30$.
- „ 11.—*Lytocarpus pennarius* (Linn.). Portion of hydroclade, $\times 70$.
- „ 12.—*Halicornaria balei*, var. *flava*, Nutting(?). Portion of hydroclade, $\times 70$.
- „ 13.—*Halicornaria hians*, var. *profunda*, Ritchie. Portion of hydroclade with hydrothecæ at a late stage of development, $\times 70$.
- „ 14.—*Halicornaria hians*, var. *profunda*. Portion of hydroclade with hydrothecæ at an early stage of development, $\times 70$.



III. DESCRIPTIONS OF NEW SHELLS IN THE COLLECTION OF THE INDIAN MUSEUM FROM BURMA, SIAM AND THE BAY OF BENGAL.

By H. B. PRESTON, F.Z.S.

Plectotropis biggiei, sp. nov.

Shell broadly conic, carinate at the periphery, rather solid, reddish brown; whorls 7, regularly increasing, covered with a laminiferous periostracum and transversely sculptured with closely set, oblique, transverse wrinkles, the last whorl descending; base of shell presenting a curiously granular appearance; sutures impressed; umbilicus very wide, deep; columella descending somewhat vertically, inflated in the middle; peristome white, reflexed, the margins joined by a very thin callus and bearing a *very slight* thickening just below the columella; aperture subquadrate.

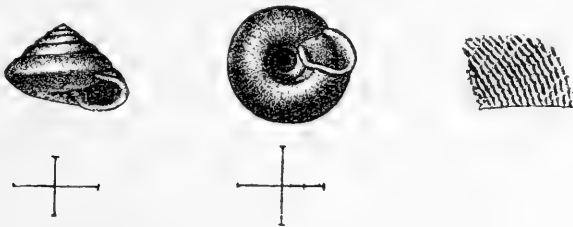


FIG. 1.—*Plectotropis biggiei*, sp. nov.

Altitude	..	..	7.5 mm.
Diam., major	..	..	10.75 ,,
Aperture, alt.	..	..	3 ,,
,, diam.	..	..	3 ,,

Hab.—Pitsamloke, Siam. (H. D. Biggie, Esq.)

Type in Indian Museum (Reg. No. M. $\frac{1418}{1}$).

Differing chiefly from *P. ptychostyla*, von Marts., its nearest ally, in its more conical shape, deeper and much wider umbilicus, narrower aperture, in being less keeled at the periphery and by the granular sculpture which is absent in *P. ptychostyla*.

Opeas innocens, sp. nov.

Shell bluntly subulate, whitish, thin; whorls 8, flat, rather sharply shouldered above and below, transversely striate with

lines of growth; sutures deeply impressed; columella descending in a slight curve, extending above into a thick, parietal callus which joins the margin of the lip above; labrum acute, simple; aperture elongately ovate.

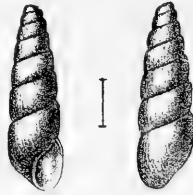


FIG. 2.—*Opeas innocens*, sp. nov.

Altitude	..	..	5.5 mm.
Diam., major	..	..	1.25 „
Aperture, alt.	..	..	.75 „
„ diam.	..	..	.25 „

Hab.—Khayon Cave, near Moulmein, Lower Burma. (Dr. N. Annandale.)

Type in Indian Museum (Reg. No. M. $\frac{4639}{1}$).

Dolium varicosum, sp. nov.

Shell ovate, perforate, white without any trace of painting, somewhat solid; remaining whorls 6, sculptured throughout with rather closely set, flat, spiral ribs, the last whorl bearing a vavex about eleven millimeters from the labrum, such as is seen in

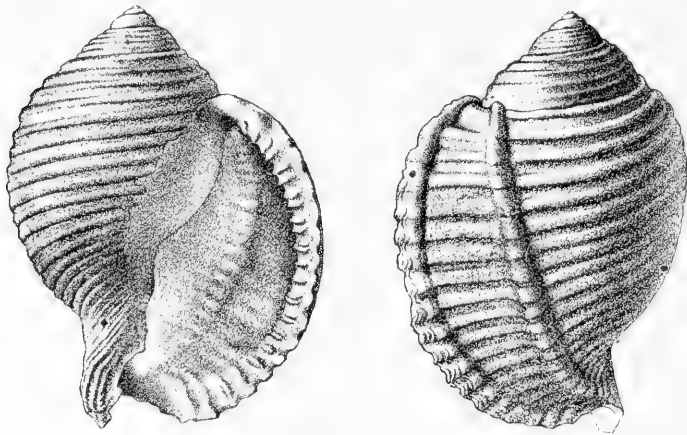


FIG. 3.—*Dolium varicosum*, sp. nov.

Cassis, but which appears to be quite normal; sutures impressed; perforation rather narrow; columella descending vertically at first, obliquely curved below, a thin, smooth callus joining it with the lip above; labrum posteriorly varicose, serrated and somewhat

coarsely denticulate just within; aperture elongately inversely auriform.

Altitude ..	..	54 mm.
Diam., major ..	..	39 ,,
Aperture, alt. ..	..	37 ,,
,, diam. ..	..	17 ,,

Hab.—Balasore Bay, Orissa Coast. (Bengal Fisheries.)

Type in Indian Museum (Reg. No. M. $\frac{4411}{1}$).

A remarkable species which is easily recognizable both by its closely set, flat ribbing and by the extraordinary vaxex on the last whorl: it has all the appearance of a comparatively deep-sea form.

Avicula smithi, sp. nov.

Shell thin, subquadrate; right valve flattish, somewhat scabrous; left valve convex, smooth, polished, both valves greyish white, tessellated with golden brown, stained in places with bright yellow and blotched with deep blackish purple; winged

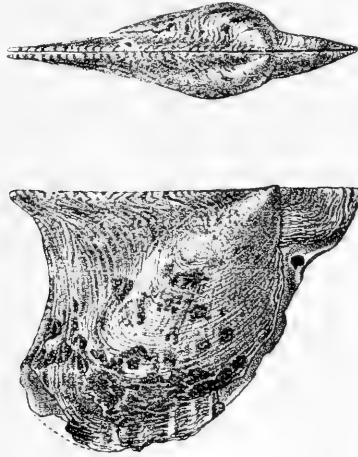


FIG. 4.—*Avicula smithi*, sp. nov.

both anteriorly and posteriorly, the anterior wing being broader and longer than that on the posterior side; dorsal margin straight; ventral margin rounded; anterior side obliquely curved; posterior side concavely sloping, rostrate below; interior of shell nacreous, iridescent.

Long. ..	..	34 mm.
Lat. (across wings) ..	..	45 ,,

Hab.—Off Gopalpur, Ganjam Coast, 24 fathoms. (Bengal Fisheries.)

Type in Indian Museum (Reg. No. M. $\frac{4314}{1}$).

Modiola jenkinsi, sp. nov.

Shell subtrapezoidal, scarcely curved, dark green shading to a paler colour towards the margins and posteriorly painted with thin, pale brown, radiate lines, marked with concentric lines of growth; umbones large, very anteriorly situate; dorsal margin somewhat straight; ventral margin slightly concave; anterior

FIG. 5.—*Modiola jenkinsi*, sp. nov.

side rather angularly rounded; posterior side sloping above, gently rounded below; interior of shell nacreous, iridescent in places.

Long.	..	.. 6 mm.
Lat.	..	.. 13'5 ,,

Hab.—Manikpatna, Lake Chilka. Forming colonies on *Ostrea lentiginosa*, Sow. (Dr. J. T. Jenkins.)

Type in Indian Museum (Reg. No. M. $\frac{4651}{1}$).

Differing from *M. evansi*,¹ Smith, from S. Siam by its narrower form and less fan-like shape; it is also much paler in colour and, except for the lines of growth, quite smooth; moreover the interior of the shell is much lighter than is the case with *M. evansi*.

¹ *Journ. of Conch.*, x, p. 368.

IV. MATERIALS FOR A REVISION OF THE PHYLACTOLÆMATOUS POLYZOA OF INDIA.

By N. ANNANDALE, D.Sc., C.M.Z.S., F.A.S.B., Superintendent,
Indian Museum.

The Phylactolæmata of the Oriental Region have hitherto attracted little attention on the part of zoologists; except a few short papers of my own in the Journal of the Asiatic Society of Bengal and these "Records," the following are the only references (besides a few bare statements as to the existence of *Plumatella* in the East) I can find in literature:—

- 1859. Carter described and figured the statoblast of a "*Lophopus*" (*Lophopodella carteri*) and recorded *Plumatella repens* and *P. stricta* from Bombay (*Ann. Mag. Nat. Hist.* (3), vol. iii, p. 332).
- 1862. Mitchell recorded a species of "*Lophopus*" from Madras (*Quart. Journ. Micr. Sci.* (3), vol. ii, p. 61).
- 1865. Hyatt named the Indian "*Lophopus*" described by Carter as *Pectinatella carteri* (*Comm. Essex Inst.*, vol. iv, p. 203).
- 1887. Kraepelin described *Plumatella philippinensis* (*Deutschen Süßwasser-Bryozoen*, part i, p. 118, footnote).
- 1895. Meissner recorded the discovery of statoblasts of *Lophopodella carteri* in E. Africa ("Moosthiere," p. 6, in *Deutsch-Ost. Africa*, vol. iv).
- 1904. Rousselet placed this species in his new genus *Lophopodella* (*Journ. Quekett Micr. Club*, 1904, p. 51).
- 1906. Kraepelin described *Plumatella javanica* (*Mitth. Naturh. Mus. Hamburg*, vol. xxiii, p. 143).
- 1908. Loppens referred *Plumatella javanica* to *P. emarginata* as a variety (*Ann. Biol. Lacustre*, iii, p. 162).

The following papers by Oka on Japanese forms are also of importance to students of the Indian species of the Phylactolæmata:—

- 1891. "Observations on Freshwater Polyzoa," in *Journ. Coll. Sci. Imp. Univ. Tokyo*, vol. iv.
- 1907. "Zur Kenntnis der Süßwasser-Bryozoenfauna von Japan," in *Annot. Zool. Japon.*, vol. vi.
- 1908. "Ueber eine neue Gattung von Süßwasser-bryozoen," in *Annot. Zool. Japon.*, vol. vi.

As, however, a considerable proportion of the Phylactolæmata of India are identical with or very closely related to northern forms, many of which are practically cosmopolitan, the bulk of the literature regarding them is to be sought in memoirs that refer directly to the fauna of Europe or North America. Fortunately it is possible to regard two separate memoirs as having been unusually complete at the several dates on which they were published. I refer to Allman's *Monograph of the Fresh Water Polyzoa* (1856) and Kraepelin's *Süsswasser-Bryozoen* (1887-1892). It is possible to differ from the conclusions at which either or both of these authors arrived; but the wealth of detail and accuracy of delineation displayed in their works are beyond criticism. Another important memoir is Jullien's "Monographie des Bryozoaires d'eau douce" (*Bull. Soc. zool. France*, vol. x, 1885), which, in spite of the lack of critical instinct and the somewhat splenetic attitude to former writers displayed by its author, contains much valuable information. Braem's "Untersuchungen über die Bryozoen des süßen Wassers" (*Bibliotheca Zoologica*, vol. ii, 1890) deals mainly with anatomy and development but gives good descriptions of the European Phylactolæmata, while Loppens has recently published a concise summary of our present knowledge of the group (*Ann. Biol. Lacustre*, vol. iii, p. 141, 1908).

There are few groups in the animal kingdom on which the views of different authorities as to taxonomy are at greater variance than the Phylactolæmata, and this is the case even as regards the main divisions of the group. The following classification is adopted because it seems to be most convenient :—

Order PHYLACTOLÆMATA.

Family I.—PLUMATELLIDÆ.

Ectocyst well developed; base of zoarium never modified to form an organ of progression.

Subfamily A. Zoëcia tubular;

lophophore circular or oval when expanded; statoblasts without air-cells

Fredericellinæ.

Subfamily B. Zoëcia tubular or concealed in a gelatinous syncœcium; lophophore horse-shoe-shaped when expanded; some or all of the statoblasts surrounded by a ring of air-cells

Plumatellinæ.

Family II.—CRISTATELLIDÆ.

Ectocyst absent; polypides embedded in a common syncœcium, the base of which is modified to form a creeping "sole"; lophophore horse-shoe-shaped, statoblasts surrounded by a ring of air-cells.

The Cristatellidæ consist of a single genus and probably of a single species (*Cristatella mucedo*), which, so far as is at present known, is confined to Europe and North America. Both the *Fredericellinæ* and the *Plumatellinæ* are, however, represented in India. The former subfamily consists of a single genus, in which four species can now be distinguished; while seven genera, five of which have been recorded from India, constitute the *Plumatellinæ*.

Family PLUMATELLIDÆ.

Subfamily **Fredericellinæ**.

Genus FREDERICELLA, Gervais.

Zoæcia cylindrical, each arising directly from another. *Zoarium* recumbent or, more usually, with upright branches. *Statoblasts* flat, oval or kidney-shaped, surrounded by a stout chitinous ring. *Polypide* slender and elongate; the tentacles of the lophophore filiform, not very numerous.

Until recently, although several distinct phases or varieties had been described as species, it was only possible to recognize a single form as worthy of specific rank, namely the Holarctic *F. sultana* (Blumenbach). Four species may, however, now be distinguished, although they are all closely allied to one another and might perhaps be regarded rather as local races or subspecies. They are *F. sultana* (Europe, N. America, N. and S. Africa), *F. australiensis*¹ (New South Wales), *F. indica* (Western India) and *F. cunningtoni*² (Lake Tanganyika, Central Africa). The following key will serve to distinguish them.—

Key to the species of Fredericella.

- A. Ectocyst never heavily encrusted.
 - a. Statoblast smooth on both surfaces.
 - a. Lophophore circular .. *F. sultana*.
 - a'. Lophophore oval .. *F. australiensis*
 - a'. Statoblast with minute prominences on the upper surface.
 - Lophophore circular .. *F. indica*.
- B. Ectocyst heavily encrusted with sand grains.
 - Lophophore circular; zoæcium short (statoblast unknown) .. *F. cunningtoni*.

Fredericella indica, Annandale.

Rec. Ind. Mus., iii, p. 373, fig. (1909).

To my recent description of this species I need only add that the lophophore is accurately circular when fully extended. The

¹ Goddard, *Proc. Linn. Soc. N. S. Wales*, xxxiv, p. 489, pl. xlvii (1909).

² Rousselet, *Proc. Zool. Soc. London*, 1907, p. 254, pl. xv, figs. 9, 10.

statoblasts of specimens taken in Travancore were invariably oval, although varying considerably in proportions; but some of the statoblasts of those from the Bombay Presidency were distinctly kidney- or bean-shaped.

In both localities the specimens were taken in November, but in different years. Those from Travancore (1908) were found to be undergoing a process of regeneration owing to the development of statoblasts *in situ*, and only a few polypides were fully developed. Those, however, from Bombay (1909) were in a much more vigorous condition, although even in their case many of the polypides were not fully formed. It seems not improbable that *F. indica* is one of the species that dies down at the beginning of the hot weather, and is regenerated by the sprouting of the statoblasts, either in the old zoëcia or on a new site, at the beginning of the Indian "winter."

Subfamily Plumatellinæ.

Key to the genera of Plumatellinæ

1. Statoblasts without hooked processes.
 - A. Zoëcia cylindrical, not embedded in a gelatinous investment.
 - a. Zoëcia arising directly from one another; no stolon; free statoblast oval .. *Plumatella*.
 - a'. Zoëcia upright, arising singly or in groups from a linear stolon; free statoblasts oval .. *Stolella*.
 - B. Zoëcia cylindrical, embedded in a structureless gelatinous investment.

Zoëcia arising from a ramifying stolon; statoblasts circular .. [Stephanella]
 - C. Polypides embedded in a hyaline synœcium that conceals the cylindrical form of the zoëcia.
 - c. Polypides upright, their base far removed from that of the zoarium when they are expanded .. *Lophopus*.
 - c'. Polypides recumbent for the greater part of their length at the base of the zoarium .. [Austrolella].¹

¹ *Austrolella*, gen. nov.—Zoëcia recumbent, aggregated into small linear groups, which are connected with each other by stolon-like lobes and embedded

2. Statoblasts armed (normally) with hooked processes.
- A. Processes confined to the extremities of the statoblast; zoaria remaining separate throughout life *Lophopodella*.
- B. Processes entirely surrounding the statoblast; many zoaria embedded in a common gelatinous investment so as to form large compound colonies *Pectinatella*.

Those genera of which the names are enclosed in square brackets have not been recorded from India, while the occurrence of *Lophopus* in this country is doubtful. *Plumatella* is represented by at least four European species as well as by two peculiar, so far as is known, to the Oriental region. Of the latter, one has only been recorded from a single locality in the Bombay Presidency, while the other was originally described from Java. *Lophopodella* and *Pectinatella* are each represented in the Indian fauna by a single species; that of the former genus occurring also in E. Africa and being specifically identical with a race found in Japan, while that of the latter is only known from India and Burma but has a very close Japanese ally.

Genus PLUMATELLA, Lamarck.

Zoarium recumbent or partially upright, branching freely, often in two planes. *Zoæcia* cylindrical, arising directly the one from the other, sometimes upright, greatly elongated and agglutinated together; at least the older zoæcia in each zoarium commonly recumbent. *Statoblasts* frequently of two kinds, free and fixed; the latter devoid of air-cells and fastened to the support of the zoarium; the former surrounded by a well-developed ring of air-cells, without processes at the periphery, never more than about 0.6 mm. in length, oval in outline. *Polyptide* never with more than about 60 tentacles.

Hardly any two authorities are agreed as to the number of species and varieties that should be recognized in this genus, and it is generally believed that the zoaria exhibit very great individual variation. Observations, however, carried out on a considerable amount of European material as well as a large Indian collection, make me inclined to believe that this is not the case, but rather that a considerable number of forms exist which breed remarkably true even in very diverse conditions. The fact that it is possible to recognize the majority of the well-established European "species" among

in a structureless gelatinous mass. Statoblasts oval, without hooked processes, intermediate in size between those of *Lophopus* and those of *Plumatella*. Type *Lophopus lendenfeldi*, Ridley, *Journ. Linn. Soc. London, Zool.*, vol. xx, p. 62 (1890).

Indian specimens, as well as several of the varieties, would suggest that the type is preserved with considerable exactness, and this view is confirmed by the fact that several distinct forms are frequently found growing together in conditions so absolutely identical that their zoaria are intertwined.¹

Two better tests as to the distinctness of "forms" could not, in my opinion, be found; but whether these "forms" should all be recognized as "species" is another question. Personally I think that it would be inconvenient to adopt a course so extreme. I have been forced, therefore, to devise a test for distinguishing "species" from "varieties." The test adopted is as artificial as all such tests must be in the present unsettled state of biological knowledge. I have called those forms (*i.e.*, groups of specimens) "species," the differences between which are so constant and so clear that it is possible to express the more important of them in the form of a key to the genus; while my "varieties" are groups of specimens separated from those comprised in the nearest species by differences that do not appear to be altogether constant or are of a kind that cannot be represented easily in words or numbers. The question of "subspecies" (*i.e.*, local races) hardly arises as regards *Plumatella*, for there is little evidence that such races exist in the genus.

Up to the present time I have been unable, owing to unfavourable climatic conditions, to carry out direct biological experiments as to the effect of environment on the individual zoarium in the Polyzoa, but evidence obtained in the unnatural environment of an aquarium is usually unsatisfactory as regards such points, and I think that the facts stated above will at any rate make my position clear as regards the "species" and "varieties" described below.

Key to the Indian species of Plumatella.

Group I. (*Repens* group.)

Ectocyst more or less rigid, pigmented or colourless; tip of the zoecia rounded when the polypide is retracted.

1. All the zoecia entirely recumbent, having the aperture on the dorsal surface and a strong furrowed keel; ectocyst colourless and transparent; free statoblast elongate . . . *P. javanica*.
2. The younger zoecia as a rule forming long free branches, each with the aperture at the tip; a furrowed keel never

¹ In a pond in the Calcutta Zoological Gardens I have found the following forms growing together in this way:—*P. fruticosa* (with the phase *coralloides*), *P. emarginata* (with the phase *benedeni*), the varieties *diffusa* and *dumortieri* of *P. allmani*, *P. javanica* and *P. punctata*.

- present; ectocyst lightly pigmented; statoblasts elongate *P. fruticosa*.
3. Zoëcia and ectocyst as in 2; free statoblasts broadly oval *P. repens*.
4. At any rate the older zoëcia entirely recumbent, sometimes with the aperture on the dorsal surface, with a triangular colourless patch at the tip of the same surface; the ectocyst of the basal part of the zoëcium densely pigmented; free statoblast elongate .. *P. emarginata*.
5. All or nearly all the zoëcia with their bases recumbent but with their distal part free and turned upwards; the ectocyst of the basal part translucent, roughened on the surface, that of the distal part colourless and smooth, the colourless part frequently passing into the coloured part in the form of a V; free statoblasts very variable in shape .. *P. allmani*.

Group II. (*Philippinensis* group.)

Ectocyst rigid, deeply pigmented, tip of the zoëcia abruptly truncated when the polypide is retracted.

Zoëcia irregularly but strongly annulated; with a strong furrowed keel on the basal part; free statoblast elongate .. *P. bombayensis*.

Group III. (*Punctata* group.)

Ectocyst soft and flexible, much swollen; tip of the zoëcia rounded.

Ectocyst colourless; zoëcia without a furrow; statoblasts broadly oval, often asymmetrical in outline *P. punctata*.

a. *Repens* group.

Plumatella repens, Allman (? Linné).

? *Tubipora repens*, Linné, *Syst. Nat.* (Ed. x), 1758.

Plumatella repens, Allman, *Mon. Fresh Water Polyzoa*, p. 93, pl., v, figs. 1—8 (1856).

Plumatella polymorpha, *Kraepelin*, *Deutsch. Süßwass.-Bryozoen*, pl. iv, fig. 119, pl. v, fig. 122, pl. vii, fig. 139 (1887).

Plumatella repens, *Braem*, *Bibl. Zool.*, vol. vii, p. 2 (1890).

„ „ *Loppens*, *Ann. Biol. Lacustre*, vol. iii, p. 158
(*partim*) (1908).

This species is distinguished rather by negative than by positive characters, and it is perhaps for this reason that I find it difficult at present to regard the form *fungosa* as more than a variety, although the latter appears to exhibit certain peculiarities even at a stage at which it has not assumed its most characteristic features.

P. repens may be recognized by the following characters :—

- (1) The great majority of the free statoblasts in any one zoarium are broadly oval in shape, the greatest width being at least $\frac{2}{3}$ of the length.
- (2) Fixed statoblasts without air-cells are produced.
- (3) The zoöcia, when the polypides are contracted, are always round at the tip. They are never emarginate.
- (4) A *furrowed* keel is never present on the dorsal surface.
- (5) The pigmentation is never dense.
- (6) The zoöcia are slender, and the ectocyst is never very stiff, although it is never soft and contractile as in *P. punctata*, the only species, except *P. fruticosa*, with which *P. repens* is likely to be confused.

The first two of these characters will at once serve to distinguish *P. repens* from *P. fruticosa*, but it must be remembered that elongated statoblasts are occasionally found in the former species, although never in large numbers. The swim-ring of the free statoblasts of *P. repens* is rarely much, if at all, broader at the sides than at the ends.

Var. *fungosa*, Pallas.

Tubularia fungosa, Pallas, *Comment. Acad. Sci. Imp. Petropol.*, vol. xii, p. 565, pl. xiv (1768).

Alcyonella fungosa, Allman, *op. cit.*, p. 86, pl. iii (1856).

Plumatella polymorpha var. *fungosa*, *Kraepelin*, *op. cit.*, p. 124, pl. iv, fig. 112, pl. viii, figs. 140—142.

Plumatella fungosa (*partim*), *Braem*, *op. cit.*, p. 2, pl. i, fig. 2.

Plumatella repens var. *fungosa*, *Loppens*, *op. cit.*, p. 161.

The essential characters of this form seem to be (1) that the zoarium branches very profusely when still young and recumbent, and (2) that the ectocyst is surrounded by a gummy secretion. These characters cause crowding together of the zoöcia, which are forced to assume an upright growth and finally, under pressure, a polygonal form in cross-section. Dense masses, often an inch or more in diameter, are thus produced, consisting of upright parallel tubes closely packed together. Specimens from Norfolk, which Dr. F. Harmer has been kind enough to send me, show the earlier stages

of this process, while others from Russia, received from the Geneva Museum, exhibit the actual transition. Dr. Kraepelin has kindly given me some fine German examples named by him *P. polymorpha* var. *fungosa* and including both young and old zoaria, and I have examined others from England and Italy.

Although *P. repens* is here included in the Indian fauna, I am doubtful as to its having been actually found anywhere in the Oriental Region. The form recorded by Carter from the island of Bombay as *P. repens* was, as he himself recognized, the one described by van Beneden under that name and subsequently called *P. stricta* by Allman, who did not regard it as identical with Linné's *Tubipora repens*. The variety *fungosa* has not been recorded from India except by myself, and further experience both of Indian and European specimens proves that what I found was actually an extreme form of the *coralloides* phase of *P. fruticosa*.

Plumatella fruticosa, Allman.

Plumatella stricta, Allman, *op. cit.*, p. 99, fig. 14.

Plumatella fruticosa, *id.*, *ibid.*, p. 102, pl. vi, figs. 3—5.

Plumatella repens and *P. stricta*, Carter, *Ann. Mag. Nat. Hist.* (3), vol. iii, p. 332 (1859).

Plumatella princeps var. *fruticosa*, Kraepelin, *op. cit.*, p. 120, pl. vii, fig. 148.

Plumatella fruticosa, Braem, *op. cit.*, p. 9, pl. i, fig. 15.

Plumatella repens, Annandale, *Journ. Asiat. Soc. Bengal*, 1907, p. 83.

This species agrees with *P. repens* in never having the zoecia emarginate or with a furrowed keel and in having the ectocyst neither deeply pigmented (naturally¹) nor very stiff. The great majority, if not all of the statoblasts in every zoarium are, however, invariably elongate, the length being twice or nearly twice the greatest breadth. The swim-ring, however, is as a rule not much broader at the ends than at the sides. Just as in *P. repens* an occasional statoblast may be found that is elongate, so in *P. fruticosa* an occasional statoblast may be found that is short and broad; but in both species such cases are rare and must be regarded as abnormal; they therefore do not affect the question of the specific distinctness of the two forms. The zoecia of *P. fruticosa*, although frequently stout, are invariably long, so that the branches are far apart from one another; there is often a simple keel, but with no trace of a furrow, on the dorsal surface of the proximal part of the zoecium. Young colonies are recumbent but with the tip of each zoecium upturned, so that the aperture is terminal. In favourable conditions, however, horizontal or dependent branches, often of considerable length, are freely produced. The ectocyst is not sufficiently stiff to give much support to long upright branches, and the branches invariably collapse or droop if the zoarium is removed from the water. The alimentary canal is rather less stout

¹ If attached to dead wood they are apt to become stained.

than in *P. repens*. Among Indian specimens of *P. fruticosa* two varieties can be distinguished:—

Var. A has the branches long and composed of many zoëcia, while the zoëcia themselves have a diameter at the broadest part of nearly half a millimetre. The ectocyst is tinted of a delicate brownish colour.

Var. B (Allman's *Plumatella stricta*), on the other hand, has much more slender zoëcia (greatest diameter about 0.35 mm.), and its branches are sparingly produced and short, consisting of not more than three or four zoëcia each. The ectocyst, except when stained by contact with rotting wood, is practically colourless.

A third form, the *P. coralloides* of Allman, occurs frequently in India but must be regarded merely as a phase directly due to environment. When the zoarium of *P. fruticosa* becomes overgrown by a freshwater sponge, as is frequently the case, the zoëcia are forced by the pressure of its growth to assume an upright direction and often reach a considerable length without branching, in order that their apertures may be on the surface of the sponge. As a rule, however, they are not exactly parallel to one another, and they never assume a polygonal form in cross-section or become agglutinated together. Frequently, moreover, they give rise to branches on the surface of the sponge, even after reaching a considerable length. Zoaria may be found in which the proximal (*i.e.*, the oldest) part is free and has the typical form of *P. fruticosa*, while the younger parts, being embedded in a sponge, have assumed the form of *P. coralloides*.

P. fruticosa is a common form in India, especially in Lower Bengal. I have examined specimens of var. A from the island of Bombay, from Igatpuri in the W. Ghats, from Lahore in the Punjab (Major J. Stephenson, I.M.S.), and from Calcutta and other places in the Ganges delta. Form B I found growing in abundance in Shasthancottah lake in the plains of Travancore (some of my specimens from that locality being embedded in gelatinous masses formed by a colonial rotifer and having assumed to some extent the *coralloides* characters), and in a jungle stream at the base of the W. Ghats in the same State; I also obtained specimens at Igatpuri, and at Kawkareik in Lower Burma. Specimens collected in a pond at Darjiling (alt. 6,900 feet) by Mr. R. Kirkpatrick and now in the British Museum, probably also belong to form B of this species but are in too bad a condition of preservation to make a definite statement possible.

Indian specimens of var. A agree well with a specimen from Germany sent me by Dr. Kraepelin labelled *Plumatella princeps* var. *fruticosa*, while examples of the *coralloides* phase from Calcutta and elsewhere in Bengal closely resemble a specimen of this phase from the neighbourhood of Edinburgh.

In some of the Calcutta tanks *P. fruticosa* grows with great luxuriance. It is only found, so far as my experience goes, during

the cold weather, beginning to flourish in November and dying down again about March. I have not seen resting statoblasts in this species.

Plumatella emarginata, Allman.

Plumatella emarginata, Allman, *op. cit.*, p. 104, pl. vii, figs. 5—10.

Alcyonella benedeni, *id.*, *ibid.*, p. 89, figs. 5—11.

Plumatella princeps var. *emarginata* (*partim*), Kraepelin, *op. cit.*, p. 120, pl. iv, fig. 108, pl. v, fig. 123.

Plumatella emarginata, Braem, *op. cit.*, p. 9, pl. i, figs. 12, 14.

Plumatella emarginata (*partim*), Annandale, *op. cit.*, p. 89.

The main characters of this species, which is remarkably constant, are the following:—

- (1) The zoëcia are slender and nearly cylindrical, often quite straight, never dilated at the tip, often (in young or poorly developed colonies) adherent to the support of the zoarium by their whole length. The distal part of each zoëcium is never strongly bent upwards when the base is recumbent.
- (2) The aperture is frequently situated on the dorsal surface of the zoëcium rather than at the tip.
- (3) The ectocyst is stiff. It is deeply pigmented at the base of each zoëcium but colourless at the tip.
- (4) The ectocyst is defected on a triangular area situated at the tip of each zoëcium on its dorsal surface,¹ the apex of the triangle, which points away from the aperture, being frequently produced as a furrow running along the middorsal line of the zoëcium. The defective area is hyaline, but the furrow is never very deep.
- (5) The statoblast is invariably elongate (not less than $1\frac{1}{2}$ times as long as broad), and (the capsule being small and relatively short) the swim-ring is usually much narrower at the sides than at the extremities.
- (6) In well-developed zoaria part of each zoarium is usually flat and recumbent and part upright, the upright part consisting of branches ramifying in one plane.
- (7) The main axis of the branches forms an angle less than a right angle with that of the zoarium, and is approximately straight.

In this species the distinction between the dorsal and the ventral surface of the zoëcium is often retained, even in the case of entirely free zoëcia, more clearly than it is in allied forms, the ventral surface keeping its flattened appearance. The coloration is characteristic. The basal part of the zoëcium varies from a fairly pale brown to nearly black in tint, but is always opaque and contrasts with the white tip, which is by no means coterminous with the emargination.

¹ This is what is meant by calling the zoëcium emarginate.

Both free and fixed statoblasts are produced in considerable numbers.

In Lower Bengal at any rate, most well-developed zoaria assume, sooner or later, the form described by Allman under the name *Alcyonella benedeni*. This is apparently due to the fact that the growth of the zoarium is vigorous, that proper space for its expansion, in the general absence of large areas of attachment of a suitable kind, cannot be found in a horizontal plane, and that the organism is therefore crowded. Profuse branching takes place and the branches are closely pressed together and forced to assume a vertical direction. The individual zoœcia affected become elongated, although not to the same extent as in *P. repens* var. *fungosa*; they do not lose their power of branching, that is to say, of producing daughter zoœcia; no gummy substance is secreted.¹ The masses formed are, therefore, analogous to those of the *coralloides* phase of *P. fruticosa* rather than to those of *P. repens* var. *fungosa*.

P. emarginata is a common species in the East. I have myself found it abundant in Calcutta and the neighbourhood, and also both in Upper and in Lower Burma (Rangoon and Mandalay), in the Malay Peninsula (Jalor in the Patani States) and in Lower Siam (Tale Noi, Lakon Sitamarat). Indian specimens agree with a German one sent me by Dr. Kraepelin as typical of his *Plumatella princeps* var. *emarginata*. The species is usually found in ponds, adhering to solid objects either at the bottom or on the surface, such as stones, logs of wood or large woody seeds; it flourishes in the cold weather, but small feeble colonies, with the majority of the polypides dead, may sometimes be found during the "rains" (July to September).

Plumatella allmani, Hancock.

Plumatella allmani, Hancock, *Ann. Mag. Nat. Hist.* (2), vol. v, p. 200, pl. v, figs. 3—5 (1850).

Plumatella diffusa, Leidy, *Proc. Acad. Nat. Sci. Philadelphia*, vol. v, p. 261 (1851).

Plumatella diffusa, *P. allmani*, and *P. dumortieri*, Allman, *op. cit.*, pp. 105, 106, 108, pl. viii, figs. 1—5.

Under the name *Plumatella allmani* I here group several forms that have been practically ignored by recent writers on the Phylactolæmata, except perhaps Jullien, whose synonymy cannot be elucidated without an examination of the specimens on which he worked. These forms, however, seem to me to deserve, together, specific rank, being related to *P. emarginata* but invariably distinguishable from that species. It is possible that they include more than one species, but the different forms here described must be regarded for the present as varieties.

The essential characters in which *P. allmani* differs from *P. emarginata*, the only form with which confusion is likely, are the following :—

¹ Kraepelin's *P. princeps* var. *muscosa* is not identical with "*Alcyonella benedeni*."

- (1) The zoëcia are stout and relatively short ; they are never straight or flat, but invariably have the proximal or basal half horizontal and the distal half bent vertically upwards.
- (2) The basal half in the great majority of the zoëcia is adherent, and the aperture is always terminal.
- (3) Vertical branches are rarely formed and never consist of more than three or four zoëcia.
- (4) The base of each zoëcium is usually tinted, but not very deeply ; it is invariably rough on the external surface, while the distal part is smooth, colourless and hyaline.
- (5) The free statoblast is very variable in shape and is often much broader (relatively) than that of *P. emarginata*.

Although well-developed specimens of this species often look to the naked eye extremely like the *benedeni* phase of *P. emarginata*, examination with a lens invariably reveals the characteristic differences in the coloration of the ectocyst and the growth of the zoarium.

The following varieties may be distinguished .—

Var. A. (*P. allmani*, Hancock.)

The zoëcia in this variety are always more or less distorted and are usually broader at the tip than at the base ; some or all of them are strongly emarginate and have a well-developed furrow. They are never densely pigmented as a whole, but in the older specimens obtained at Bhim Tal in the W. Himalayas there is a band of dark pigment round the middle of each zoëcium. The zoarium is never of great extent. I have found every gradation between this form as figured by Hancock and Allman's *P. elegans*.

Var. B. (*P. dumortieri*, Allman.)

This variety differs little from var. A, but the zoëcia are much more regular in shape. Allman states that the statoblast is like that of *P. repens* but figures it as distinctly elongate.

Var. C. (*P. diffusa*, Leidy.)

The growth of this variety is much more vigorous than that of the other two, and the zoaria frequently cover large areas on logs of wood and stones. The zoëcia are stouter and more strongly curved in outline ; they are often closely pressed together, so that a resemblance to the phase *benedeni* is produced. The base of each zoëcium is usually of a yellowish brown colour, but I refer to the variety with some doubt a fragmentary specimen from Bulandshahr in the United Provinces (*Major H. J. Walton, I.M.S.*) in which it is practically colourless. Even in this specimen the separation of each zoëcium into two distinct regions is quite clear. The variety closely resembles Kraepelin's figures of his *Plumatella polymorpha* var. *cæspitosa*, except that the statoblasts differ in shape (*Deutsch Süßwass.-Bryozoen*, part i, pl. v, figs. 126—128). Resting statoblasts are produced.

Although these three varieties cannot be regarded as local races, seeing that they occur in Europe or North America as well as in India, they are not usually found together. I have only seen var. A in Bhim Tal, a W. Himalayan lake several miles in length, and var. B in a tank in Calcutta, in a small lake at Kawkareik in Lower Burma and in a pond at Kurseong (alt. c. 5,000 ft.); but var. C is common all over N. India. Major J. Stephenson, I.M.S., has sent me specimens from Lahore, while I owe to Mr. R. Kirkpatrick and Capt. F. H. Stewart, I.M.S., specimens taken on different occasions, in a small pond at Gangtok in native Sikkim (E. Himalayas). I have myself found the variety growing in great abundance in the environs of Calcutta and at Rajshahi on the R. Ganges about 150 miles north of Calcutta. On one occasion I discovered a small colony in the Zoological Gardens at Alipore, growing on a brick side by side with *P. emarginata*.

Plumatella javanica, Kraepelin.

Plumatella javanica, Kraepelin, *Mitth. Nat. Mus. Hamburg*, vol. xxiii, p. 143, figs. 1—3 (1906).

Plumatella emarginata var. *javanica*, Loppens, *op. cit.*, p. 163.

This is a much more constant species than the last, related to *P. emarginata* but distinguished by characters that vary little. These characters are the following:—

- (1) The zoœcia are entirely and invariably recumbent, so that the aperture is always on the dorsal surface. They are very long and narrow and produce daughter zoœcia sparingly, so that linear series without lateral branches are sometimes formed. The emargination and furrow are strongly developed.
- (2) There is never any trace of pigment in the ectocyst, which is markedly transparent and delicate; the external surface is smooth.
- (3) The capsule of the statoblast, which is elongate, is large as compared with the swim-ring.

Dr. Kraepelin has very kindly sent me one of the types of this species, and I have found other specimens among Prof. Max Weber's collection of sponges from Java. *P. javanica* is common in Calcutta, and I obtained specimens in a canal near Srayikad in Travancore. In a freshwater sponge collected by Prof. Max Weber in Natal there are the remains of a zoarium that may belong to this species.

b. *Philippinensis* group.

The type of this group is Kraepelin's *Plumatella philippinensis* from the Philippines, and the only other species definitely known to belong to it except *P. bombayensis* is Rousselet's *P. tanganyikæ* from Central Africa. The group would therefore appear to be essentially a tropical one.

Plumatella bombayensis, Annandale.

P. bombayensis, Annandale, *Rec. Ind. Mus.*, vol. ii, p. 169, figs. 1, 2.

Zoarium. The whole colony is recumbent but branches freely and at short intervals in a vertical plane, so that the zoecia become crowded together and the branches sometimes overlap one another. The zoarium often covers a considerable area, but growth seems to be mainly in two directions.

Zoecia. The walls of the zoecia are thick, stiff and densely pigmented; the external surface, although not very smooth, is always clean; a flat membrane, which is apparently an extension of the ectocyst, frequently extends between different zoecia and branches. The two most noteworthy characters of the zoecia are (1) their truncated appearance when the polypide is retracted, and (2) the conspicuous, although often irregular external annulation of their walls. The tip of each zoecium, owing to the fact that the tentacular sheath is soft and sharply separated from the stiffened wall of the tube, terminates abruptly and is not rounded off gradually as is the case in most species of the genus; sometimes it expands into a trumpet-like mouth. The annulation of the external surface is due to numerous thickened areas of the ectocyst that take the form of slender rings surrounding the zoecium; they are most conspicuous on its distal half. On the dorsal surface of the base of each zoecium there is a conspicuous furrowed keel, which, however, does not extend to the distal end; the latter is oval in cross-section. The zoecia are short and broad; their base is always recumbent, and, when the zoarium is attached to a stone, often seems to be actually embedded in the stone; the distal part turns upwards and is free, so that the aperture is terminal; the zoecia of the older parts of the zoarium exhibit the specific characters much more clearly than those at the growing points.

Polypide. The lophophore bears 20 to 30 tentacles, which are long and slender; the velum at their base extends up each tentacle in the form of a sharply pointed projection, but these projections do not extend for more than one-fifth of the length of the tentacles. Both the velum and the tentacular sheath bear numerous minute tubercles on the external surface. The base of the stomach is rounded, and the whole of the alimentary canal has a stout appearance.

Statoblasts. Both fixed and free statoblasts are produced, but not in very large numbers. The latter are broadly oval and are surrounded by a stout chitinous ring, which often possesses irregular membranous projections; the surface is smooth. The free statoblasts are small and moderately elongate, the maximum breadth as a rule measuring about $\frac{2}{3}$ of the length; the ring of air-cells is not very much broader at the ends than at the sides; the dorsal surface of the central capsule is profusely tuberculate. The outline of the whole structure is somewhat irregular.

This species is perhaps no more than a variety or a local race of the African *P. tanganyikæ* and is closely related to *P. philippinensis*; from the former it differs mainly in its darker and more strongly

annulated ectocyst, while it may be at once separated from *P. philippinensis* by the fact that the latter's zoëcia are smooth and polished and show no trace of annulation.

Habitat. As yet only known from Igatpuri Lake, which is situated in the Western Ghats about 60 miles N. E. of the island of Bombay at an altitude of about 2,000 feet.

Habits. I found this species common in the lake in November, 1907 and 1909. The largest zoaria were growing on the lower surface of stones, but a few were found attached to the stems and leaves of water-plants. The latter, however, did not appear to be in a very flourishing condition and were all small; their pigmentation was not so dense as that of the colonies on the stones. Probably *P. bombayensis* is a species that flourishes during the "rains," for even the most vigorous colonies appeared, in November, to be dying; there were patches among them in which the polypides had disappeared from the zoaria, and sometimes the zoaria had decayed, leaving the fixed statoblasts to mark their former position.

c. *Punctata* group.

This group comprises Jullien's genus *Hyalinella* (1893) and probably consists of a single species.

Plumatella punctata, Hancock.

Plumatella punctata, Hancock, *Ann. Mag. Nat. Hist.* (2), vol. v, p. 200, pl. v, figs. 6, 7, and pl. iii, fig. 1.

Plumatella punctata, Allman, *op. cit.*, p. 100.

„ „ Kraepelin, *Deutsch. Süßwass.-Bryozoen.*, p. 126, pl. iv, figs. 115, 116, pl. v, figs. 124, 125, pl. vii, figs. 153, 154.

The most striking character of this species is the nature of the synœcium. Although the zoëcia retain their tubular nature to a very considerable extent, the ectocyst is so soft and as a rule so much inflated that this character of the zoëcia is masked, and frequently the zoarium appears to represent an almost uniform flat area rather than a branching structure. The movements of the polypides, moreover, affect the ectocyst directly, and it is drawn together by the contraction of the muscles in a way that does not occur in other species of the genus. There is therefore no difficulty in recognizing living specimens; but preserved ones are often apt to be confused with *P. repens*. The statoblasts are, however, often even broader than is the case in that species, and even in badly shrunk specimens the ectocyst is always thicker. The zoëcia are colourless or nearly so, either hyaline or translucent.

In Europe Kraepelin has recognized two seasonal forms as varieties under the names *prostrata* and *densa*, the former being found in summer, the latter in autumn. In var. *prostrata* the zoëcia are elongated and entirely hyaline, with the external surface nearly smooth, whereas in var. *densa* they are much stouter

and more closely crowded together, and have the ectocyst distinctly clouded and the external surface tuberculate. Var. *densa* has also bigger and broader statoblasts than var. *prostrata*. In the Indian race the degree of transparency of the ectocyst is somewhat variable, but the surface is, in all the specimens I have seen, slightly tuberculate and the method of growth resembles that of var. *densa*. There appears to be a difference as regards the number of tentacles, for while European specimens are said to have from 40 to 60, specimens from Calcutta have from 30 to 40. The statoblasts of Indian specimens resemble those of var. *densa* in being broad, but are rather smaller; they are frequently somewhat asymmetrical in outline. Fixed statoblasts have not been found.

I have, as yet, only found *P. punctata* in the neighbourhood of Calcutta, where it is common in ponds in which a slight infiltration of brackish water may be suspected. It flourishes during the "rains" and the cold weather, but I can detect no difference between specimens taken in July and others taken in January.

Genus *STOLELLA*, Annandale (1909).

This genus is closely allied to *Plumatella* and especially to the *punctata* group, from which it is probably derived. The young zoarium closely resembles that of *P. punctata*, and it is only after several zoëcia have been produced that the characteristic mode of growth becomes apparent, long processes being given out from the base of certain zoëcia so as to take the form of a stolon, and all the zoëcia assuming an upright position.

Stolella indica, Annandale.

Stolella indica, Annandale, *Rec. Ind. Mus.*, vol. iii, p. 279 (1909).

This species is often found growing in close proximity to *Plumatella punctata*, from which even young zoaria may be readily distinguished by their strong emargination and furrow. The upright position of the older zoëcia and the false stolon that separates the little groups of zoëcia in well-developed colonies are, of course, clear diagnostic characters. I have never seen a zoarium with lateral or vertical branches. The free statoblasts are variable in length; they are usually elongate as a whole, but the capsule is nearly as broad as long and the swim-ring is exceedingly narrow on both faces at the sides. The fixed statoblasts, which are produced in considerable numbers, are very variable in proportions. The chitinous ring surrounding them is stout and is surrounded in its turn by a narrow membranous ring indistinctly ornamented with a reticulate pattern. The surface of the capsule is smooth. The tentacles possess a short and feebly festooned velum at the base.

S. indica is common in the neighbourhood of Calcutta during the "rains" and has been taken by Major Walton at Bulandshahr in the United Provinces.

Genus *LOPHOPUS*, Dumortier.

The *punctata* group of *Plumatella* is to some extent intermediate between *Lophopus* and the typical species of its own genus, but in *Lophopus* the tubular character of the zoëcia is still further masked by the development of the syncœcium, which takes the form of a gelatinous vertical sack. The polypides are invested in this sack in an upright position, as is most clearly seen when they are fully expanded. Their lowest point is separated by some little distance from the base of the zoëcium, except when the whole organism is very strongly contracted. The free statoblasts resemble those of *Plumatella* but are much larger; fixed statoblasts are not formed.

Only two species of *Lophopus* can be recognized, namely *L. crystallinus* (Pallas) and *L. jheringi*, Meissner. The former occurs in Europe and North America and has the statoblasts of an oval shape with the extremities much produced; the latter has only been found in Brazil and has the statoblasts irregularly polygonal or almost circular.

It is doubtful whether any species that really belongs to *Lophopus* occurs in India, for the species found by Carter in Bombay must be placed in the genus *Lophopodella*, while there is no information available regarding a form said to occur in Madras.

Genus *LOPHOPODELLA*, Rousselet (1904).

There has been much confusion between this genus and *Lophopus*, but a recent examination of living specimens, which I was able to keep under observation for some weeks, shows me that I was wrong in regarding the two as identical. Rousselet's genus may be distinguished by the following characters:—

- (1) The polypides are arranged in the syncœcium in such a way that they radiate from a common centre. When fully expanded they do not stand upright but recline with their main axis at a tangent to the base of the syncœcium, from which they are not far separated.
- (2) The statoblasts normally bear at either end a series of delicate chitinous processes each provided with several pairs of minute hooks.

From *Pectinatella* the genus is distinguished, (1) by the fact that different zoaria do not become embedded in a common jelly, and (2) by the structure and position of the chitinous processes of the statoblasts.

Three species of *Lophopodella* may be distinguished.

- | | |
|---|-----------------------------------|
| I. Extremities of the statoblast produced .. | <i>L. capensis</i> . ¹ |
| II. Extremities of the statoblast convex or sub-truncate .. | <i>L. carteri</i> . |
| III. Extremities of the statoblast concave .. | <i>L. thomasi</i> . |

¹ Miss I. B. J. Sollas, "A new freshwater Polyzoön from S. Africa," *Ann. Mag. Nat. Hist.* (8), vol. ii, p. 264 (1908).

All three species occur in Africa, but *L. carteri* was discovered in Bombay and is represented in Japan by what appears to be a local race.

Lophopodella carteri (Hyatt).

Lophopus sp., Carter, *Ann. Mag. Nat. Hist.* (3), vol. iii, p. 335, pl. viii, figs. 8—15 (1859).

? *Lophopus* sp., Mitchell, *Quart. Journ. Micros. Sci.* (3), vol. ii, p. 61 (1862).

Pectinatella carteri, Hyatt, *Comm. Essex Inst.*, vol. iv, p. 203 (1865).

Lophopodella carteri, Rousselet, *Journ. Quek. Micr. Club*, 1904, p. 47, pl. iii, figs. 6, 7.

Lophopus lendenfeldi, Annandale (nec Ridley), *Journ. Asiat. Soc. Bengal*, 1907, p. 92, pl. ii, figs. 1—4.

Lophopus lendenfeldi var. *himalayanus*, id., *Rec. Ind. Mus.*, vol. i, p. 143, figs. 1, 2.

Lophopus carteri, id., *ibid.*, vol. ii, p. 171, fig. 3.

The characteristic features of the zoarium of this species are obscure unless it be examined either in a healthy living condition or preserved with the polypides fully expanded. The general form of each zoarium as viewed from above is circular or oval, with more or less distinct lobate projections, which become more conspicuous when the animals are strongly contracted. The centre of the structure, owing to the arrangement of the polypides, appears to be practically empty when the polypides are expanded, so that the whole has a ring-like appearance. Viewed from the side it resembles a low mound. The gelatinous parts are colourless, but the stomach has a greenish tinge. The tentacles are long and slender but much shorter than those of *Austrellella lendenfeldi*; they usually number about ninety. The shape and proportions of the statoblast vary considerably, but the extremities are never concave. The number of chitinous processes is not constant, and their degree of development varies even in specimens from the same locality.

The form described by me as *Lophopus himalayanus* is distinguished by the small number of its tentacles and the absence or abortive condition of the processes on the statoblast. This form, however, must be regarded merely as an abnormality in which the polypides are stunted and the statoblasts retain immature characters. I have recently received typical specimens of *L. carteri* from Bhim Tal, in which the abnormal form was originally discovered.

Pectinatella davenporti, Oka, of which Dr. Oka has been kind enough to send me specimens, is certainly, as Loppens indicated,¹ a form of *L. carteri*, the range of which, therefore, extends from E. Africa to Japan. In India, however, the occurrence of the species is sporadic. It was originally found in Bombay and is common in Igatpuri Lake; possibly it occurs at Madras. It is usually found either on the lower surface of stones or among gelatinous green algæ on the stems of plants.

¹ "Les Bryozoaires d'eau douce," *Ann. Biol. Lacustre*, vol. iii, p. 166 (Decr. 1908).

Genus PECTINATELLA, Leidy.

The structure of the individual zoarium of this genus agrees closely with that found in *Lophopodella*, but in fully mature colonies a large number of zoaria secrete a common investment or basal membrane of a gelatinous nature, so that compound colonies, often of gigantic size, are produced. The statoblast is entirely surrounded by chitinous processes, each of which bears at its extremity a pair or a small bunch of hooks.

Three species of *Pectinatella* can be distinguished, *P. magnifica* from N. America and the continent of Europe, *P. gelatinosa* from Japan, and *P. burmanica* from Bengal and Lower Burma. They may be distinguished as follows :—

- | | | | |
|------|---|---------|-----------------------|
| I. | Statoblast circular, surrounded by processes which are much longer than the hooks at their tips | .. .. . | <i>P. magnifica.</i> |
| II. | Statoblast somewhat irregular in shape but nearly circular; the processes not or barely longer than the hooks | .. .. . | <i>P. burmanica.</i> |
| III. | Statoblast subquadrate; processes as in II | | <i>P. gelatinosa.</i> |

Pectinatella burmanica, Annandale.

Pectinatella burmanica, Annandale, *Rec. Ind. Mus.*, vol. ii, p. 174 (1908).

Zoaria circular or oval, sometimes constricted in the middle owing to approaching division, of large size, embedded in large numbers in a greenish jelly of considerable thickness, the compound colonies often measuring a yard or more in length and several inches in diameter.

Polypides large, the free part measuring when fully protruded about 5 mm. Tentacles numbering about 90, slender, moderately long, tuberculate; the velum at their base narrow, never strongly festooned.


Statoblast almost circular but invariably a little irregular in outline, measuring about 1.75 mm. in diameter, provided with a complete ring of very short chitinous projections each of which bears a pair of hooks at the tip. The hooks normally bend backwards in a wide arc and nearly touch the edge of the statoblast; sometimes they are distorted or abortive.

Young zoaria resemble those of *Lophopodella carteri* both in general structure and in histology but may be distinguished, even before the secretion of the common jelly, by the large size of the polypides and the green colour of the syncœcium.

I described *P. burmanica* from a statoblast found in March in a lake at Kawkareik in Lower Burma, but later in the year (October) discovered mature colonies growing in great abundance in the Sur Lake near Puri in Orissa. They grew on the stems of rushes, which they completely encased. Both larvæ and statoblasts were being given out in large numbers.

In concluding these notes I have to thank the many colleagues who have assisted me with specimens and information. For Indian examples of the Phylactolæmata I am indebted to Major H. J. Walton, Major J. Stephenson and Capt. F. H. Stewart of the Indian Medical Service, and to Mr. R. Kirkpatrick, to whom I must also express my thanks for assistance as regards exchanges with the British Museum. The named European specimens sent me by Dr Kraepelin and Dr. W. Michaelsen from Hamburg have proved exceedingly useful, while I cannot express my admiration too strongly as regards the exquisite preparations given me by Mr. C. Rousselet. I owe to Dr. F. Harmer's generosity some valuable specimens and am indebted to Prof. Max Weber, Dr. Oka, Mr. T. Evans and the authorities of the Geneva Museum for others. Last but not least the Trustees of the Indian Museum are entitled to my gratitude for the liberality with which they have allowed me to travel in India and Burma.

This paper is merely a preliminary attempt to classify the Indian representatives of a very difficult group. It will, I hope, be followed by the publication of a more ambitious work. I need, therefore, hardly say that criticism will be most valuable, especially on the part of those who have a practical acquaintance with the Phylactolæmata of Europe and N. America.





V. STUDIES ON THE AQUATIC OLIGO-CHÆTA OF THE PUNJAB.¹

By J. STEPHENSON, M.B., D.Sc. (Lond.).

I.—ON *Lahoria*, A NEW GENUS OF THE NAIDIDÆ ALLIED TO *Branchiodrilus*, MCHLSN. (*Chætobranchus*, BOURNE).

The worm of which the following is a description shares with *Branchiodrilus* the remarkable peculiarity of the possession of gill-processes on the anterior part of the body; the hair-setæ of the dorsal bundles are contained within the more anteriorly situated gills; but further back, though still in the region of the gills, a certain number of these setæ project freely.

Branchiodrilus semperi, the only species of the genus originally named *Chætobranchus* by Bourne, was found by him in a tank in Madras town [2]. It has not since then (1890) been recorded from any place in India, nor has it since been encountered at all under what may be described as natural conditions; though Beddard [1] has found specimens in the *Victoria regia* tank at the Botanical Society's Gardens in Regent's Park. The chief difference between this form and the one now to be described, and the feature which makes it necessary to constitute a new genus for the reception of the latter, is the absence of gills and dorsal setæ from the most anterior segments (ii-v) in the present form, and their presence on these segments in the form described by Bourne.

Lahoria hortensis, sp. nov.

The worm was found in a small pond in the Lawrence Gardens, Lahore. This pond is artificial, having been first made about two years ago; it is kept supplied with canal-water by a small irrigation channel, and has been for some time overgrown and almost choked up with aquatic plants. The specimens were first obtained early in July, 1908. The animals lived then in fair numbers on and amongst the water-weeds near the edge of the pond, and it was not difficult to obtain specimens by passing a small net through this vegetation. One or two samples of mud from the bottom of the pond did not seem to contain any of these worms. Specimens were also found later in the year in the same place.

External characters (plate vii, fig. 1).—The worms are usually from about two-thirds of an inch to an inch, or 16–25 mm. in length, and less than a millimetre in diameter, on an average .5 to .75 mm. The number of segments varies considerably; specimens which were not preparing to divide showed from 90 to 120

segments; many were, however, preparing for fission, and one of these showed seventy-nine in its anterior and ninety-one segments in its posterior half, or 170 altogether. In addition to the segments recognizable as such, there is always a posterior tapering region of the body where growth is apparently taking place actively, and where distinct segments have not yet been differentiated.

The *prostomium* is bluntly conical in shape, and is well marked, though by no means so large relatively as is figured for *Branchiodrilus* (Bourne, *loc. cit.*, fig. 1). There are no eyes. The first few segments, as far as the first gills, form a region of the body which is in preserved specimens somewhat narrower than that which succeeds it, though this is not obvious in the living and moving animal; indeed this region may then appear somewhat swollen. A peculiarity noticed on a number of different occasions was that when after a somewhat prolonged examination a specimen died and began to disintegrate under the microscope, this latter process began by a shrivelling up of the region of the first ten gills, this region of the body becoming wrinkled and much narrower in diameter than before.

The anterior portion of the body is pigmented (plate vii, fig. 2), the *pigment* being black and occurring in granules more or less closely aggregated. On the dorsal surface there is a blotch of pigment about the level of the mouth, just in front of the level of the cerebral ganglion, and there are a few scattered granules towards the tip of the prostomium. A segmental distribution of the pigment is hardly to be recognized in segments ii-iv; but after this it is distributed as well-marked transverse bands one in each segment. These bands become less dense as one proceeds posteriorly, and after about the twentieth segment are inconspicuous; scattered pigment spots occur for some distance further, but these, too, ultimately disappear. On the ventral surface the appearances are more variable; there may be well-defined segmental bands here also, or there may be only scattered spots; but in any case the pigment is less than on the dorsal surface.

The segments are delimited externally by a fairly well-marked *annulation*.

The *branchial processes* are dorso-laterally situated hollow projections of the body-wall, cylindrical in shape, longest in the anterior part of the body, and gradually diminishing posteriorly. The first of these processes are situated on the sixth segment as a rule, but occasionally on the fifth. It is not always easy in the living and moving worm to be certain of the exact numbering of the segments; and I therefore examined a number of individuals fixed and mounted in balsam; in nine such specimens the gills began in segment v in one, in vi in the rest.

The first gill on each side is a little shorter than the second; when turned forwards these reach well in front of the tip of the prostomium. The branchial processes of the anterior part of the body are easily visible to the naked eye, and are over a millimetre in length; the longest I have measured was 1.6 mm. After the

anterior segments they decrease somewhat in size, and become progressively smaller and smaller; about the fortieth segment they may be only .4 mm. long, about the fiftieth .3 mm., and after the seventieth they are mere tubercles. These figures are approximate only, and are given for the sake of illustration, as there is a certain amount of individual variation. The processes are however recognizable, though as minute tubercles only, till within quite a short distance of the growth zone at the posterior end of the body; in this respect the present form seems to differ from *Branchiodrilus*, where, according to Bourne's figure, there may be as many as sixty-seven posterior segments without any recognizable processes.

In an animal which was preparing to divide asexually, the anterior portion of seventy-nine segments had recognizable gills throughout its length, the most posterior, just in front of the budding zone, being .13 mm. long. The first gill of the posterior animal was .35 mm. long, the second .48 mm.; as above, small tubercle-like processes were visible to within a short distance of the hinder end, practically as far as distinctly differentiated segments were to be recognized.

These processes in the anterior part of the body contain the

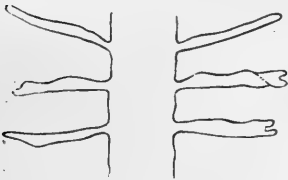


FIG. 1.—Irregularities of shape of branchial processes in *Lahoria hortensis*.

dorsal hair-setæ; they are, like the general surface of the body, ciliated; they present here and there short stiff hairs, presumably sensory; they are hollow, and body-cavity corpuscles may be seen moving into or out of them; they contain two well-marked blood-vessels, one afferent and one efferent. They are usually regularly cylindrical in shape, but occasionally show irregularities of outline, and there may be a tendency to forking

at the free end (text-fig. 1); they are somewhat constricted at their attachment to the body-wall. They are in the natural condition stiffened by the contained setæ, but appear to possess a certain amount of contractility, since in fixed and preserved specimens the long anterior processes are usually found much curved, often into the shape of a semicircle.



FIG. 2.—Ventral seta of *Lahoria hortensis*.

The setæ, except in the most anterior region, are in four bundles per segment, two dorsal and two ventral. The ventral setæ (text-fig. 2) begin in the second segment; they are of the usual \int -shape, forked distally, the two prongs being equal in length, the proximal prong, however, being twice as thick at its base as the distal. The nodulus is slightly distal to the middle of the length of the seta, the proportions of the proximal and distal parts of the seta being 7:6 or 8:7. The total length of these

setæ varies from .15 mm. in the anterior to .13 mm. in the posterior part of the body. I have not been able to recognize any difference in type between the setæ of the anterior and posterior segments. There are usually four or five setæ in each ventral bundle.

The *dorsal setæ* are of two kinds, long slender hair-setæ, and short straight singly-pointed needle-setæ. The hair-setæ are quite smooth; they begin in the same segment as the gills, within which they are at first contained; two such setæ usually extend into each gill, of which one, somewhat longer than the other, may reach very nearly to the tip of the gill; like the gills themselves, their length will thus be, in extreme cases, considerably more than a millimetre.

At a varying distance from the anterior end, about the fortieth to the fiftieth segment, the hair-setæ begin to project freely from the surface of the body; as a rule, however, only one of each bundle does so, rarely two; the gills still contain a seta; a comparatively short one however, in correspondence with the shorter gills. The first free dorsal setæ are longer than the gills they accompany; e.g., the setæ may be .51 mm. long, the gill .4 mm.; but the disproportion may be much greater—setæ .88, gill .28; or setæ .5, gill .144 mm. These hair-setæ, like the gills they accompany, gradually decrease in length posteriorly, though not so markedly as the gills. The needle-setæ, usually two per bundle occur along with the hair-setæ as short pointed rods scarcely projecting beyond the level of the body-wall. I have not seen any sickle-shaped setæ, as described for *Branchiodrilus*.

It has been mentioned that the gills are ciliated; these *cilia* are extremely fine and delicate, and though sometimes visible without much difficulty, are frequently only to be recognized by the movements of small particles in the water in their vicinity. Similarly over the general surface of the animal; the whole body seems to be ciliated, though the cilia themselves are only occasionally to be discerned; their presence is however evidenced by the commotion of minute particles in the water near the surface of the body.

The body-cavity is traversed by well-marked *septa*; these are perforated in places, allowing the lymph-corpuscles to pass from segment to segment. These *corpuscles* are round, and very granular; they are not pigmented.

Alimentary canal.—The mouth cavity is ciliated; the pharynx, an oval dilatation, occupies the first few segments, narrowing about segment vii to become the œsophagus. This is a straight tube continued posteriorly into the intestine; there is no sharp demarcation between these, and it is difficult to say where one ends and the other begins. Antiperistaltic movements are frequent, and may be violent, in the intestine; they may extend as far forwards as the tenth segment. A postero-anterior ciliary action may occur in the intestine of these worms, similar to that observed in *Nais*, *Pristina*, *Slavina*, etc.

Vascular system.—The blood is yellowish red, and contains no corpuscles. The dorsal vessel contracts from behind forwards; it is incorporated with the wall of the intestine, and like the intestine is covered by a layer of chloragogen cells. The ventral vessel is non-contractile, and is separate from the alimentary canal, with which it is connected in each segment by at least two vessels which pass into the wall of the latter. Besides branching vessels to the body-wall there are present in each segment a pair of lateral loops, which in the anterior part of the body extend into the gills (plate vii, fig. 3), the limbs of the loop forming the afferent and efferent vessels of these organs. The afferent vessel, springing from the dorsal vessel, is in this part of the body contractile; further back, where the branchial processes are small, the lateral loops do not extend into them, and no part of the loops is contractile; the lateral loops exist, however, though much reduced in

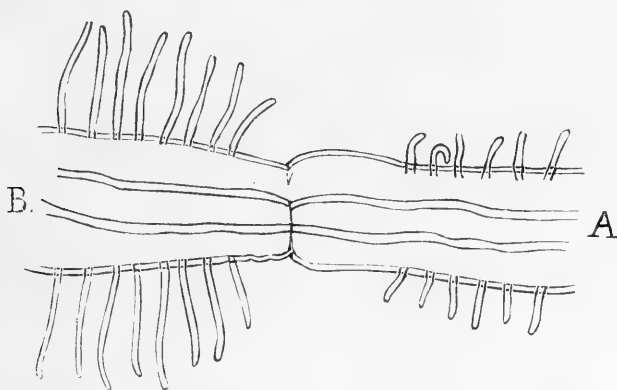


FIG. 3.—Region of approaching division in a specimen of *Lahoria hortensis*; showing portions of both anterior and posterior animals without gill-processes, and hence consisting of newly budded segments: A = anterior animal; B = posterior animal.

size, back to the hinder end of the animal. In the first five segments the lateral vessels do not present the appearance of regular loops, but form an extremely irregular and complicated plexus.

The *nephridia* begin by an open ciliated mouth; parts, at least, of the nephridial tube are also ciliated. I am not certain as to the segment in which they begin, my observations (which were a matter of some little difficulty, since these organs are not in this region very conspicuous) being discordant; in one case the first nephridium seemed to be in segment ix, in another in xi, and again in xiv, xv, xvi and xvii; it is possible that the position varies. They end some little distance in front of the posterior extremity of the animal; thus the last thirteen seta-bearing segments may have none. They become smaller and smaller posteriorly, appearing as small loops in contact with the ventral vessel and attached to the alimentary canal, somewhat as if they were budded out from the latter.

The *nervous system* has the usual relations. The two halves of the cerebral ganglion appear to be more distinct than is often the case in the Naididæ, and in the living condition were seen as two separate ganglia united by a transverse commissure; this is not apparent in preserved specimens.

Asexual reproduction.—In the description of *Branchiodrilus*, Bourne mentions the absence of a budding zone between the two components of a chain, and remarks that the process of division resembles rather a simple fission of the animal into two. The present form, however, shows a distinct, though not extensive, budding zone. A reference to text-fig. 3 will illustrate this. The specimen had almost reached the stage of complete division; and the two components separated, in fact, when the specimen was being transferred to balsam. It will be seen that the last branchial processes of the anterior animal (A) are still of some considerable length, and that the most posterior portion of this animal has no branchial processes at all; this last portion, therefore, is evidently a new production, or the series of branchial processes would have been continued over it. Similarly the anterior portion of the hinder animal (B); the ventral setæ (not shown in figure) are small—hence new productions, not a continuation of the original series; and, as usual, these anterior segments are without gill-processes, which would have been present, and even of moderate size, had these segments been a continuation of those of the anterior animal.

It appears, therefore, that the posterior segments of the anterior of two still conjoined animals are produced in a budding zone, and that the same is the case with the anterior five segments of the posterior component. It is interesting to compare this phenomenon with what occurs in *Chaetogaster* [10] and *Nais* [11]; in both these forms the anterior region, comprising five segments which are differentiated from the rest by the distribution of the setæ, is formed as a new production in the budding zone; in the present form also these segments are differentiated from the rest (by the absence of dorsal setæ), and are formed in the budding zone; while in *Branchiodrilus*, where there is no differentiation, the budding zone is inconspicuous, being limited presumably, as far as the posterior animal is concerned, to the production of the prostomium and first segment. *Genital organs* have not been observed.

Systematic position.—The presence of branchial processes alone would not be sufficient to ally this form in any close connection with *Branchiodrilus*, since the genus *Dero* among the Naididæ also possesses similar organs, and there is no reason to suppose that such physiologically similar organs may not have arisen independently.

But when, in addition to the mere occurrence of branchial processes, we consider their distribution in the anterior part of the body, their gradual diminution in size posteriorly, their length and shape, and the fact that anteriorly they enclose the dorsal hair-setæ, while posteriorly these setæ project freely, we must

conclude that we have here a collection of morphological resemblances which are comparatively unimportant from a physiological standpoint, and which it is in the highest degree improbable should have arisen independently.

Admitting then the close connection of the two forms, is it possible to unite them in the same genus? Most of the differences between the two are obviously of only specific value; such are the greater extension posteriorly of the branchial processes in the present form; the absence of sickle-shaped setæ in the dorsal bundles, and of any difference between the anterior and posterior setæ in the ventral bundles; the colourless character of the cœlomic corpuscles; and, possibly, the pulsation of the anterior lateral vascular loops and the ciliation of the general body-surface, which two last characters do not appear to have been observed in *Branchiodrilus*.

The difference in the anterior limit of the dorsal setal bundles (and branchial processes) belongs, however, to a different category. Such a feature has generally been held to be of generic and not merely specific value. Thus the presence of dorsal setæ on all segments from the second onwards is mentioned as a feature in the generic diagnosis of *Branchiodrilus* in Bourne's original paper [2], in Beddard's Monograph of the Oligochæta [1], and by Michaelsen [5]; a similar feature is the chief, if not the only, generic distinction between *Naidium* and *Nais*; Beddard ([1], p. 281), merging together a number of genera of other authors under the one name *Nais*, does so largely because they "agree in the important fact that the first five segments are cephalized,—that the dorsal setæ do not commence until the sixth segment," and by implication would exclude from the genus any form which did not show this cephalization. Similarly *Pristina* and *Naidium* are united by him on the ground of the absence of this feature. Bourne [3] also believed that the number of cephalized segments is constant for the genus, and thought it probable that *Dero jurcata*, possessing four achætous dorsal segments, should on this account be removed from the genus, since the other members of it have five such segments.¹

It seems necessary, therefore, to erect for the present form a new genus, for which I suggest the name *Lahoria*, with *hortensis* as a specific distinction. I believe notwithstanding, on the ground of the similarity of distribution of the branchial processes and of their relations to the setæ in the two forms, that the connection between the present form and *Branchiodrilus* is a close one; and if this be admitted, it is perhaps worth while asking whether a cephalization which affects only the setal distribution (for the absence of gills on segments ii-v of the present form is evidently correlated with the absence of the setæ which are necessary to

¹ On the other hand Michaelsen [5] unites into one genus *Paranais* the *Naidium naidina* of Bretscher, *Paranais littoralis* of Czerniavsky, and *Uncinaiis (Ophidonais) uncinata* of Levinsen, though their dorsal setæ begin respectively on the second, fifth and sixth segments.

stiffen them) has the systematic value hitherto generally attributed to it.

The same question is suggested by the fact that the cephalization is itself a variable feature, sometimes more, sometimes fewer segments being so differentiated. Thus, while in most of the genera of the Naididæ which show this feature the dorsal setæ begin in segment vi, they begin in iii in *Amphichæta*, in v in *Bohemilla*. Again, the feature varies within the same genus; in *Dero* some species bear the first dorsal setæ on segment v, others on vi. Lastly, the feature varies in individual specimens of the same species; this has already been stated for the present form; it is asserted for *Nais communis* by Piguet [9]; and it possibly occurs in a *Slavina*, according to my observations [11], though these may possibly have been made on specimens which had separated before the complete production of their anterior segments in the budding zone, and in which possibly the full number would subsequently have been formed.

II.—ON THE REPRODUCTIVE ORGANS OF *Nais variabilis*, FIGUET, VAR. *punjabensis*, AND OF *Chætogaster orientalis*, MIHL.

The usual mode of reproduction in the Naididæ is the asexual, by fission. The sexual organs have not hitherto been much used in the discrimination of species, and are not referred to in specific diagnoses; they cannot be said to be well-known in more than a limited number of species, and in many have not even been seen. It is probable, nevertheless, that a fuller knowledge of the sexual organs of the Naididæ would be of considerable systematic value; with regard to the genus *Nais* for example, Michaelsen [6] says, "Die bedauerliche Unsicherheit, die noch immer in der Diagnostizierung der Arten des Genus *Nais* herrscht, mag meiner Ansicht nach am leichtesten durch eine exacte Klarstellung des bisher zur systematischen Gliederung dieser Gattung nicht in Rücksicht gezogenen Geschlechtsapparates gehoben werden." The following account of the sexual organs of two species, one of them belonging to the genus *Nais* referred to above by Michaelsen, may therefore be useful.

Nais variabilis, Piguet, var. *punjabensis* (plate viii, fig. 1).

In a former paper [11] I gave an account of certain features of the reproductive apparatus of this form, as far as they could be made out by microscopic examination of the living animal. Any such account must, however, be very incomplete, since after the formation of the clitellum none of the details are any longer visible; and, as a matter of fact, I had not then seen the male efferent apparatus, which is perhaps the most important part of the system for comparative purposes.

The present description is founded on sections prepared from specimens taken in the Shalimar Gardens, near Lahore, in March,

1909. The animals were present in one of the tanks in considerable numbers, along with *Chælogaster orientalis*; and a fair proportion of both species were in a condition of sexual maturity. For the sake of completeness I have incorporated in the present account a certain number of the facts recorded in my earlier paper.

Both sexual and asexual reproduction may go on together. The testes are the first organs to be formed, and appear on examination of the living worm as homogeneous hyaline masses attached to the posterior face of septum 4/5. The sperm-morulæ ripen in the vesicula seminalis, but may sometimes be seen in the body-cavity of the anterior part of the animal, as far forwards as the third or even the second segment; and I have previously noted that slight violence may cause spermatozoa to be discharged through a rupture of the body-wall at the tip of the prostomium.

The vesicula seminalis, or sperm-sac, forms early, and is properly (plate viii, fig. 1) an extension of septum 5/6; later it becomes much dilated, extending backwards through the sixth, seventh and eighth segments, and finally may even reach the tenth.

The relations of the funnel of the vas deferens will be understood after reference to fig. 1. The mouth is turned backwards into the sperm-sac; it is of fair size, and the lip of the funnel appears in some specimens to be much prolonged on one side (apparently not always the same side), so that the plane of the opening is very oblique. The tube is fairly broad, and is lined by cells of approximately cubical shape; it at first passes vertically down along the septum, then takes one or two bends, but is not coiled. It opens by a rather wider portion into the atrium, on the anterior face of the latter, a little below the middle of its height. Its more or less horizontal portion is surrounded by prostatic cells, in two or more layers. The atrium is approximately spherical, is lined by cells which are a little higher than broad, and has only a thin external muscular coat. The passage to the exterior is short, and opens into a shallow funnel-shaped depression of the surface; the passage and funnel-shaped depression are lined by columnar cells. On a surface view of the animal these depressions are distinguishable as clearer spaces in the opaque clitellum.

The ovaries form soon after the testes, and are attached to the posterior face of septum 5/6. The ovisac is a diverticulum of septum 6/7; its relations may be seen in fig. 1. The sperm-sac is included within it, and the ova lie as a rule behind the sperm-sac, sometimes as far back as segment x; they may however lie on one side of it, so that some sperm-morulæ or spermatozoa may occupy a position posterior to that of the ova. Eggs are seen in various stages of development; in their later stages they accumulate within themselves an enormous amount of yolk-matter; I did not in my former paper recognize how enormous (for so small an animal) this aggregation of yolk might be (y, fig. 1; a much larger mass is shown in fig. 21 of my previous paper); and I was led to describe it and the spherical glancing particles of which it is composed as

something apart from the ova. I have not seen any trace of female apertures in my specimens.

The spermathecae are in the fifth segment, opening externally not far behind the level of septum 4/5. At first they are small, somewhat pear-shaped or sausage-shaped, extending vertically upwards. Later they become much elongated, and extend backwards into the seventh segment, being contained within the cavity of the sperm-sac. In this stage they are full of spermatozoa; the wall of the receptacle is thin, and its cavity sharply marked off from that of the passage to the exterior, where the lumen is very narrow, and the wall thick (fig. 1).

The clitellum forms after the sperm-sac has developed, but before the spermathecae and male ducts. When fully formed, it includes segments v, vi and vii, ending by a fairly definite margin both in front and behind. It consists of a single layer of cells, much larger and taller than those over the general surface of the body; these cells in sections prepared in the usual way are seen to have their nuclei near their base, while the greater part of the remainder of the cell shows a large vacuole (fig. 1). On examining the surface of the clitellum in the living animal, it is seen to be tuberculated, and each tubercle appears to be compounded of a number of smaller ones: the large tubercles seem to correspond to individual cells, while each smaller tubercle corresponds to a circular refractile particle, of the same appearance as the glancing particles of yolk in the ripe ovum; when the animal breaks up under examination, the disintegration of the clitellum gives rise to a number of circular masses, each compacted of a number of these particles; these masses appear to be each a portion of an epithelial cell of the clitellum,—the superficial portion apparently, which in the prepared sections is represented by the vacuole and surrounding cell-substance. The appearance of the surface of the clitellum under an oil-immersion lens is represented in plate viii, fig. 2.

The genital setae are described in the paper already referred to.

Chaetogaster orientalis, mihi (plate viii, fig. 3).

When I first [10] gave a description of the present species of the genus *Chaetogaster* under the specific name *pellucidus* (which I have since learnt was preoccupied), I had only had the opportunity of observing the sexual organs in a single specimen. I have now to give a more complete description, as well as to correct certain errors of interpretation in my former paper.

The specimens on the examination of which the present account is founded were obtained near Lahore in February and March, 1908. Other sexually ripe specimens have been obtained from Shalimar during the present month, March, 1909. The animals therefore, like the *Nais* previously described, have their period of sexual maturity in the early part of the year in this climate.

Both sexual and asexual reproduction may go on together. This is noted by Piguet [9] for *C. diastrophus*, which, according to

that author, buds at all times except when in an advanced condition of sexual development. In the present species however the limitation just expressed does not hold; all the specimens I have seen, whether sexually ripe or not, show one or more zones of budding; the single individual is never met with, but always a chain.

The testes seem to disappear early, and I could not distinguish them in a specimen which showed sperm-morulæ in all stages of development, but no other genital organs, male or female, except the ovaries in an early stage. A small granular mass situated near the ventral body-wall and a short distance in front of the funnel of the vas deferens, seen in a specimen (plate viii, fig. 4) which had developed the male efferent apparatus but not the clitellum, perhaps represented a testis, whose disappearance may have been somewhat delayed.

The funnel of the vas deferens is in segment v, on the anterior face of septum 5/6; it is ciliated. From it the vas deferens runs backwards in segment vi, with a somewhat curved course in living specimens, to the atrium; this is an oval or stoutly spindle-shaped dilatation of the tube, from which a short ejaculatory duct leads to the exterior. The male aperture is at the level of the setæ of segment vi, which are modified as described below (genital setæ). There is no prostate.

There is also no sperm-sac. Sperm-morulæ in all stages of development are scattered throughout the body-cavity of the animal; and not only through the body of the anterior animal which contains the reproductive organs, but through all the members of the chain. Spermatozoa may be seen passing from one segment to another through the incomplete septa, and may reach as far forwards as the pharyngeal region.

The ovaries are two cellular masses (described as testes in my former paper) in segment vi, at the level of or slightly anterior to the atrium on each side. They seem to appear early; one specimen showed two hyaline protoplasmic aggregates in which cell outlines were not (in the living condition) visible; these were suspended in the ventral part of the body-cavity on fine strands passing between the alimentary canal and body-wall, one on each side at a level a little in front of the setæ of segment vi; with the exception of sperm-morulæ, these, which were apparently an early stage of the ovaries, were the only signs of sexual organs.

There is no ovisac, and the ova ripen in the general body-cavity. Though ova are sometimes met with in the posterior animals of a chain, they are more usually found collected in the posterior part of segment vi, and here may cause a fairly definite backward bulging of the septum. The larger size of the egg-masses as compared with the sperm-morulæ probably occasions the restriction of their wanderings. What I figured in my earlier paper as an ovary is such a collection of ova.

The ripe eggs are of considerable size, and consist mainly, like those of the species of *Nais* previously described, of aggregations of glancing particles of yolk, opaque in mass by transmitted light.

The aggregate, when it has attained some size, is visible to the naked eye as a brilliant white spot.

A curious condition was found in a number of animals examined about the same time of the year as those containing well-marked sexual organs. Those to which I now refer had no clitellum, and no male organs or male products, but showed throughout their extent masses of what was apparently yolk-substance. In some cases these masses were large, filling up nearly the whole diameter of the body-cavity; in others they were numerous and small, somewhat resembling sometimes the white cœlomic corpuscles of the Punjab variety of *Nais variabilis* [11], but showing no nucleus on staining. In a few cases small isolated masses of ova were found along with these aggregations of yolk. These animals may have been individuals which had passed through their sexual stage and had failed to get rid of all their female products; or possibly they were the posterior animals of a chain, into which, contrary to the usual rule, female products had spread; the chain then breaking up, these products had been retained by the posterior animals without any means of getting rid of them. The eggs would, on this supposition, have entered the posterior components of the chain while still small, and would have formed their yolk there; eventually breaking up they might thus give rise to the appearances observed.

The spermathecae are two short oval structures attached to the posterior face of the septum which delimits the short œsophagus from the distended crop. This is probably septum $4\frac{1}{5}$ (not $3\frac{1}{4}$, as I assumed in my earlier paper), and the organs are, as commonly in the Naididæ, in segment v. They open externally by a short passage; the pore has somewhat tumid lips. They develop rather late, and may be absent after the full development of the ovary and male efferent apparatus.

The clitellum is situated primarily on segment vi, and spreads later half-way over both v and vii, thus coming ultimately to occupy a space of about two segments. It is a tuberculated area, the tubercles being at first minute and discrete. Each tubercle appears singly as a small round clear particle; but the region as a whole is opaque, though not so densely opaque as in other Naididæ, e.g., *Nais* and *Pristina*. The clitellum forms late, and may still be absent after the establishment of all the other organs. The order of development of the various organs is thus: testes, ovaries, male efferent apparatus, spermathecae, clitellum.

The genital setæ are the modified setæ of the sixth segment. They make their appearance during the time of development of the male efferent apparatus; thus in a specimen in which the funnel was not yet ciliated, and

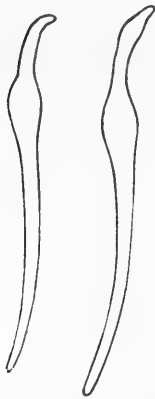


FIG. 4.—Two genital setæ of *Chaetogaster orientalis*.

where the ejaculatory duct was not yet formed (the atrium appearing as a rounded mass sessile upon the inner side of the body-wall), there were, in addition to the normal setæ of the segment, small setæ with the characteristic distal ends of the genital setæ developing beside the normal setæ in the body-wall. The genital setæ (text-fig. 4) are shorter and stouter, as well as fewer in number (*e.g.*, three on each side) than the normal setæ of the segment. The nodulus is very large and prominent, and near the distal end; the distal end is blunt and not forked. These setæ vary somewhat in shape, as for example in the degree of bluntness of the end, and they may or may not present a slight swelling just proximal to the tip.

III.—ON A SPECIES OF *Dero* FOUND IN LAHORE; A CONTRIBUTION TO THE *Dero*-QUESTION.

A number of specimens of this form were discovered in the mud from a pond near the boarding house of the Government College, and were brought to my notice by Lala Bishambar Das, my demonstrator, in November, 1908. The pond has since been drained, and the form has not been met with again.

External characters.—The animals were thin and filiform when extended, in length from 10 to 12 mm. Most of the animals were preparing to divide, and showed a zone of newly budded segments about the middle of their length. The number of distinguishable segments in each half of such an animal was about twenty. There were no eyes. The prostomium was bluntly conical, and the posterior end of the body was slightly swollen in a club-shaped manner. The animals moved backwards quite easily.

Gill-processes.—The anus opened posteriorly at the bottom of a funnel-shaped depression, the base of the funnel facing dorsalwards. Ventral and posterior to the funnel, the posterior end of the body was prolonged into a pair of finger-shaped lobes, which could be curved dorsalwards and thus bent over the gill-processes about to be described, but were not completely retractile, though they could be appreciably shortened. These processes were not ciliated, and did not contain blood-vessels: they bore a number of sensory "hairs."

On each side of the funnel, extending in a line forwards and dorsalwards from the posterior tactile processes just described, were four vascular gill-processes. These diminished in size from behind forwards, the most anterior being thus the smallest. All were rounded, tuberculated, ciliated, and vascular; they were very contractile, and hence their appearance varied much from time to time. The smallest, most anterior gill on each side was a projection of the margin of the funnel; the other three appeared to be inserted just within the margin in such a way that when fully expanded the margin of the funnel disappeared as a continuous line, but when contracted the margin of the funnel appeared as a

separate and distinct line enclosing the bases of the gill-processes. A number of variations, in different animals and at different



FIG. 5.

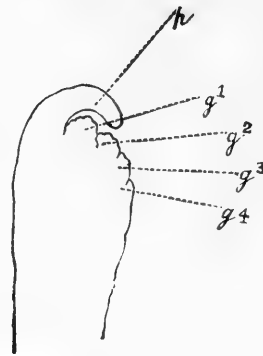


FIG. 6.

FIGS. 5, 6.—Posterior end of body of *Dero* sp.: *p*. = palp; *g*¹.—*g*⁴. = gill-processes. Fig. 5 shows a much contracted condition, the gills not projecting from the funnel at all.

times, are shown in the figures (plate vii, figs. 4—6, and text-figs. 5 and 6).



FIG. 7.—Dorsal needle-seta of *Dero* sp., showing relative sizes of prongs of fork, and a second slight irregularity of outline distal to nodulus.

Setae.—The dorsal setal bundles began on the fifth segment; each bundle consisted of one hair- and one needle-seta. The hairs were fine, smooth, pointed, and about .16 mm. long, or nearly as long as the body of the animal was broad. The needles had a slight double curve (text-fig. 7), and were forked distally, the prong on the outer side of the curve being slightly shorter and much thinner than that on the inner side; the nodulus was situated at the junction of the distal and middle thirds, and there was a second slight nodulus, or rather perhaps an irregularity of contour merely, a little way distal to the first. In length these needles were about .05 mm.

The ventral setæ (text-fig. 8) were of the usual double-curved and forked type, usually four, occasionally two or three in a bundle; the bundles began in the second segment. Two types were distinguishable; those of the second, third, and fourth segments had the prongs of the fork of the same thickness at their base, and the distal prong half as long again as the proximal; in the remaining segments the prongs were almost equal in length (the proximal being possibly very slightly the longer), and the proximal was twice as thick as the distal at its base. The length of the setæ varied from .06 to .05 mm., those of the anterior segments being slightly longer than those of the posterior; the thickness was about the same, 2.2μ throughout.



FIG. 8.—Ventral seta from a posterior segment of *Dero* sp.

The position of the nodulus was found to vary regularly in each bundle. This may be illustrated by the following tables:—

(a) Setal bundle of iv segment—

Total length.	Prox. to nodulus.	Distal to nodulus.
.058	.026	.032
.058	.029	.029
.062	.032	.030
.054	.032	.021

(b) Setal bundle of a posterior segment—

Total length.	Prox. to nodulus.	Distal to nodulus.
.056	.026	.029
.056	.029	.026
.057	.035	.022
.053	.035	.018

The series in each case begins from the innermost seta of the bundle. It will be seen that in each bundle the inner seta has the nodulus proximal to the middle of its length, while in the outer seta the nodulus is markedly distal; and that the intermediate setæ show intermediate conditions.

Lymph corpuscles may be present or absent, and when present they were of two kinds. Both were spherical; but one variety contained a number of shining white granules, while the other contained a small number of fairly large yellow refractile spheres, looking like small oil droplets. These two kinds of corpuscles were similar to those described for the Punjab variety of *Nais variabilis* [11] (plate viii, fig. 6).

Alimentary canal.—The pharynx occupied segments ii, iii and iv, and the œsophagus v and vi. Around the œsophagus, in segments v and vi, were lobular hyaline masses somewhat resembling the “septal glands” of *Pristina*. There was no distinct stomach;

chloragogen cells covered the alimentary canal as far forwards as septum 6/7 (plate viii, fig. 5).

Circulatory system.—The dorsal vessel was attached to the alimentary wall as far as septum 6/7, where it became free. The ventral vessel was non-contractile, was quite separate from the intestine except posteriorly, and gave off segmental branches to the intestine, which entered a ventral intestinal sinus, or median vascular channel in the intestinal wall. Posteriorly, at a little distance in front of the hinder end of the body, the ventral vessel became joined to the wall of the intestine; finally it bifurcated, the two branches curving round dorsalwards and then gently bending inwards to unite and form the posterior end of the dorsal vessel. Before meeting, they branched once or twice; the branches, however, soon re-united (plate viii, fig. 7).

There were, as a rule, five lateral commissural vessels connecting the dorsal and ventral vessels in the anterior part of the body; of these, the first was in segment vi, the last in x; the largest was that in vii, the next largest that in vi, then those in viii, ix, and x in the order given. Several variations, however, were observed; in one case the first lateral vessel was in segment vii; in another case, in addition to the five usual vessels, there was also a small vessel in v; in another case there were four only, in segments vi-ix. All these vessels were contractile.

The blood is red.

Nephridia.—The first nephridium occurred in the seventh segment; but here again there were variations. Thus in one case the first nephridium was in segment viii; in another, the first was in vii as usual, but the eighth segment had no nephridia.

It will be apparent, on looking over a list of species of the genus *Dero*, that the presence of palps at the hinder end of the body excludes the present form from all species, except *vaga*, *stuhlmanni*, *furcata*, *tonkinensis*, *schmardai* [7] and *palustris* ([8], *Aulophorus palustris*). The form of the dorsal setæ excludes it from *D. stuhlmanni*, *vaga* and *tonkinensis*; in *D. schmardai* the dorsal setæ begin in segment vi, the ventral setæ are far more numerous in segments ii-v, and the gill-processes are fewer; *D. palustris* has many more segments (50), and a larger number of gills (4 or ? 5 pairs), but this last form still awaits complete description.

The form to which the animal now described approaches most closely is *D. furcata*, Ok. The differences appear to be the following: the palps are much longer in *D. furcata*, appearing in Bousfield's figures ([4], figs. 17 and 18) to be relatively to the diameter of the animal about three times as long as in the species here described; the gills also are longer, slenderer and almost cylindrical, in three pairs, of which one pair are "secondary branchiæ," i.e., projections of the margin of the funnel only. Further, the present form differs in a number of characters from all the other species of the genus, according to the diagnostic summary given by Michaelsen [5]. Thus, according to his definition of the genus—

- (a) the ventral setæ are throughout the genus longer in segments ii-v than in the rest of the body ;
- (b) the alimentary tube is dilated to form a stomach ;
- (c) the nephridia begin in the sixth segment ;

to which may be added—

- (d) the genus does not possess cœlomic corpuscles (Bousfield [4]); but it seems nevertheless (Beddard [1]) that these are present in *D. vaga*, from which, however, the present form is far removed.

With regard to the length of the ventral setæ, I have previously stated that in the present forms, those of the anterior segments are slightly longer than those of the posterior ; but even this difference is gradual, not abrupt after the fifth segment ; nor in any case is its magnitude such that it could be used as a diagnostic character (*cf.* figures for length of various setæ, p. 73, *ant.*).

As regards a stomachal dilatation of the alimentary tube, this is stated [7] to be not well marked in *D. schmardai*.

I have not seen any account of a species of *Dero* in which, as in the present form, the nephridia begin in the seventh segment.

Lastly, the character mentioned under (d) above is not an absolute distinction between the other species of the genus and the present one ; since, as mentioned, cœlomic corpuscles are present in *D. vaga*, and may be absent in the present form.

A list of six or seven characters which distinguish this form from its nearest neighbour, especially when four of these are peculiar, or almost peculiar, to the present form alone, might perhaps be held as a sufficient warrant for the erection of a new species.

The species of the genus *Dero* are, however, variable in a high degree : this is illustrated in the present form by the variations recorded in the branchiæ, vascular commissures, cœlomic corpuscles and nephridia. Michaelsen, discussing this variability [6], alludes to the possible advisability of uniting all (European) species under two heads, *digitata*, without palps, and *furcata*, with palps. In such a case the present form would be included in *D. furcata*, which is, as we have seen, at any rate its nearest ally.

On reading Bousfield's paper already referred to, which I was only able to do after my examination of the worms had been completed, I was a little disconcerted as to the value of my observations by finding that, according to that author, "It is almost impossible to determine the species of any given example when ordinary methods, such as the compressorium or the live-trough, are alone employed ;" the reason given being that, in the case of the compressorium, the full expansion of the branchial area, which is absolutely necessary for exact observation, is prevented. I do not however now think that a thin cover-glass would so greatly reduce the length of palps and gills as to explain the great difference between his figures and mine, and I observe that Michaelsen [6], [7], [8] has lately described new species from preserved material.

Since, however, my acquaintance with the genus is limited to

the present form, I will not definitely pronounce an opinion as to whether the range of variability in the genus is such, and the characters of the form now described are so distinctive, as to render the erection of another species desirable. The above account may however be of use as a contribution to the "*Dero-frage*," concerning which Michaelsen writes [6]: "Trotz Bousfield halte ich eine Revision der Gattung *Dero*, zumal eine ausführlichere, auch die Borstenverhältnisse berücksichtigende Beschreibung der verschiedenen Formen oder Arten, noch für ein Desideratum."

As recommended by Michaelsen, I have paid particular attention to the setæ; whether the peculiar relations shown by the position of the nodulus in the several component setæ of a ventral bundle will also be found, when looked for, in other members of the genus, cannot be predicted; it has not been noticed by the last-mentioned author in his recent detailed description of *D. schmardai* [7] and *D. incisa* [6], and it may not improbably be found to be of systematic value.

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EXPLANATION OF PLATE VII.

- FIG. 1.—*Lahoria hortensis*: a somewhat diagrammatic representation of the general form of the animal. Free dorsal setæ not represented.
- „ 2.—Anterior part of body, from above (living specimen), to show pigmentation, etc.: *bch* = branchial process; *c.g.* = cerebral ganglion of left side; *comm.* = commissure between cerebral ganglia of the two sides; *m.* = level of mouth, which is indicated by an irregular black line, showing through the cerebral ganglia; *oes.* = œsophagus; *ph.* = outline of pharynx; *pr.* = thickened epithelium of prostomium; *s.* = setæ contained in branchial process.
- „ 3.—A segment in the middle of the body, showing arrangement of blood-vessels: *a.v.* = afferent vessel to gill; *bch.* = epithelium of branchial process; *d.v.* = dorsal vessel; *e.v.* = efferent vessel; *int.* = intestine; *s.* = setæ in branchial process; *sp.* = septum, to which on the other side the efferent vessel appears to be attached.
- „ 4—6.—Posterior end of body of *Dero* sp.; from various specimens, in various conditions of contraction or expansion. In fig. 4 the margin of the funnel is seen, and the insertions of the gill-processes are visible within it by transparency. In fig. 5 the gills and palp of one side only are shown; the third gill appears as a projection of the margin of the funnel; the fourth small (dorsal or anterior) gill was noted in this case as being apparently single and median; the outline of the funnel is shown within by transparency. Fig. 6 is seen from the dorsal surface looking into the funnel; the fourth (anterior) gills are not distinguishable as separate projections.
- p.* = palp; *s.h.* = sensory hairs; *g*¹—*g*⁴. = gill-processes.

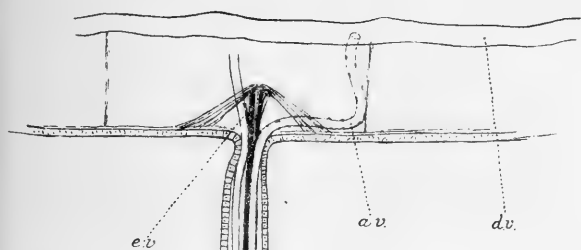
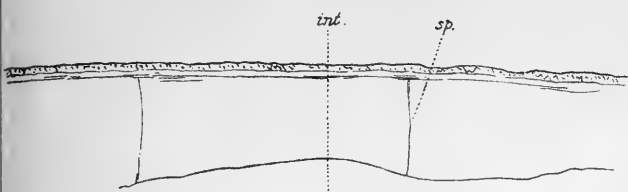


Fig. 3.

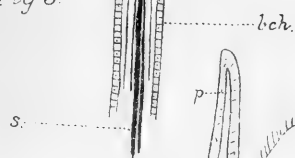


Fig. 5.

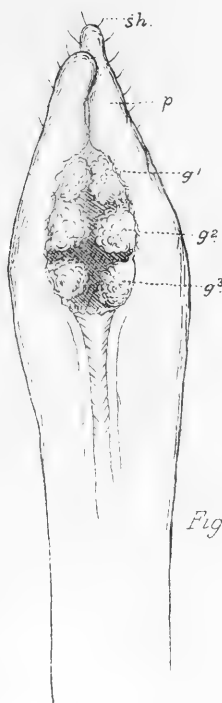
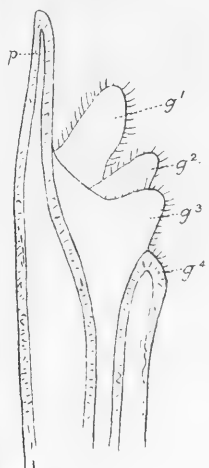


Fig. 6.

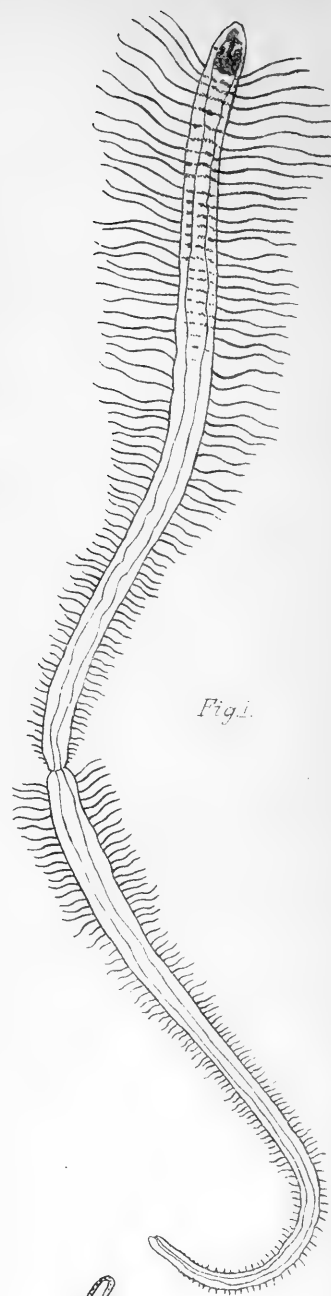


Fig. 1.

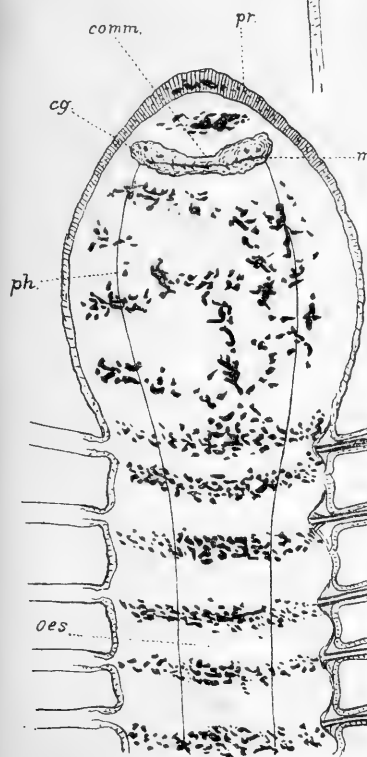


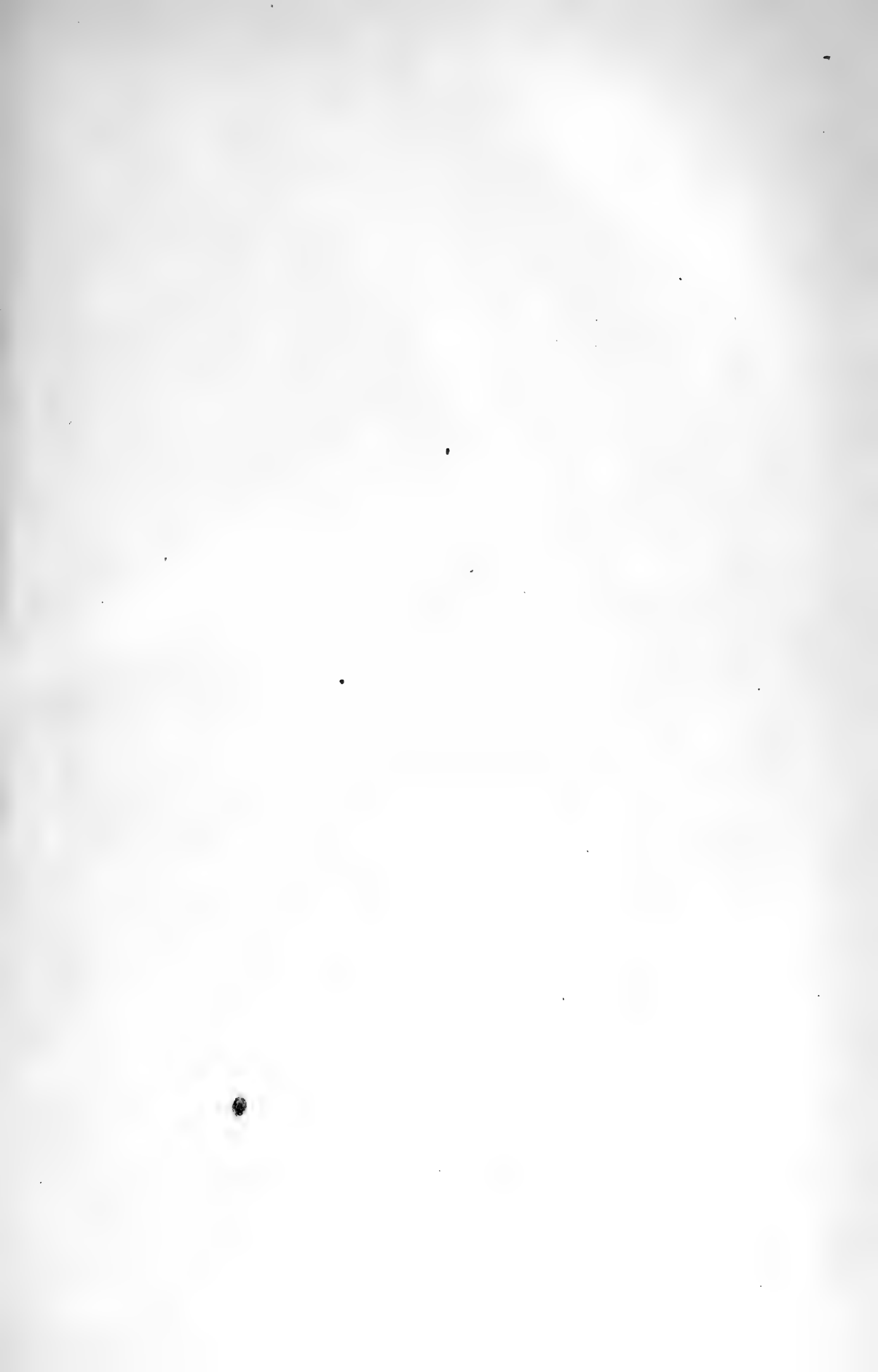
Fig. 2.



Fig. 4.







EXPLANATION OF PLATE VIII.

FIG. 1.—Reproductive organs of *Nais variabilis*, var. *punjabensis*, as seen in longitudinal section. The figure is diagrammatic, and in order to show all organs, is compiled from several successive sections.

„ 2.—Portion of clitellum of the same, as seen in surface view under oil-immersion lens.

„ 3.—Anterior part of body of *Chaetogaster orientalis*, to show reproductive organs; clitellar area lightly shaded. The living animal represented as seen by transparency, obliquely from the ventral surface.

„ 4.—Middle region of the body of the same, showing an early stage in the development of the genital organs. Ovary and testis present, but not the spermathecae; clitellum not developed. The organs of the other side were not seen.

At. = atrium; *cl.ep.* = clitellar epithelium; *c.m.* = circular muscular layer; *cr.* = crop; *f.* = funnel of vas deferens; *g.s.* = genital setae; *l.m.* = longitudinal muscular layer; *o.*, *o*¹. = ovaries; *oes.* = oesophagus; *os.* = ovisac; *ova* = ova; *ph.* = pharynx; *pr.* = prostate; *s.* = setae, *sp.*, *sp*¹. = septa; *sp.* 4/5, *sp.* 5/6, *sp.* 6/7 = the septa between the segments thus indicated; *spth.* = spermatheca; *spth*¹. = posterior extension of spermatheca into sperm-sac; *spz.* = spermatozoa entering funnel of vas deferens; *spz*¹. = spermatozoa in body-cavity; *s.s.* = sperm-sac; *st.* = stomach; *t.* = testis; *v.d.* = vas deferens; *y.* = yolk of ripening ova; σ = male aperture.

„ 5.—Anterior part of body of *Dero* sp.: *d.s.*⁵—*d.s.*⁸ = dorsal setae of fifth to eighth segments; *gl.* = glands surrounding oesophagus; *int.* = intestine; *m.* = mouth; *oe.* = oesophagus; *ph.* = pharynx; *pr.* = prostomium; *v.s.*²—*v.s.*⁸ = ventral setae of second to eighth segments.

„ 6.—Lymph corpuscles in body-cavity: *a* and *b*, with large yellowish droplets; *c*, with white refractile particles.

„ 7.—Blood-vessels of hinder end of body of *Dero* sp.: *al.* = outline of ventral wall of alimentary canal; *br.* = branches of ventral vessel to intestine; *d.v.* = dorsal vessel; *v.s.* = ventral setal bundles; *v.v.* = ventral vessel.

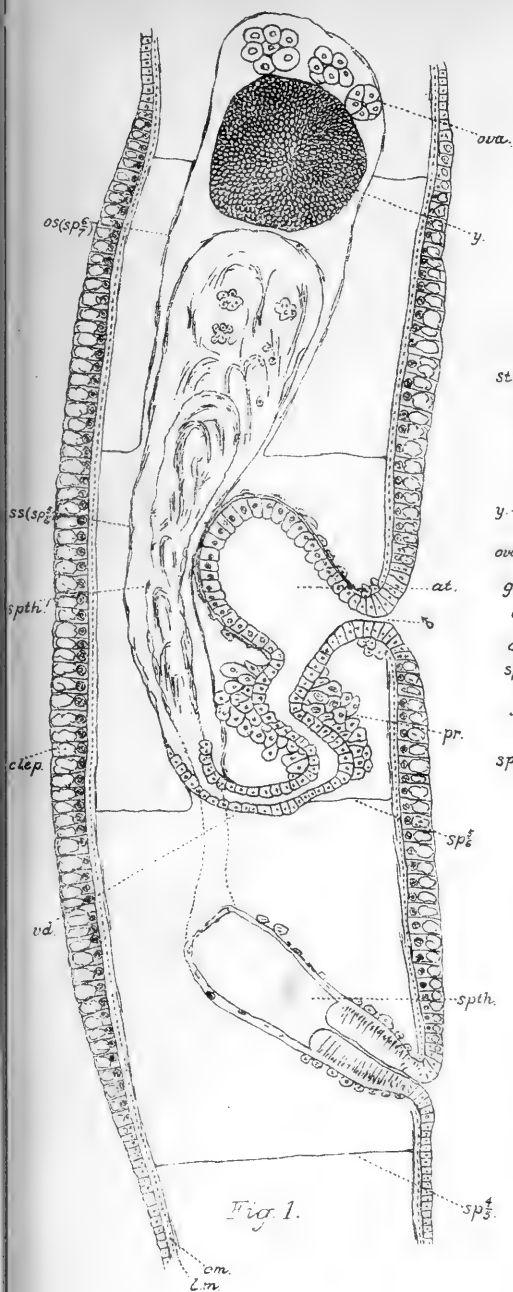


Fig. 1.

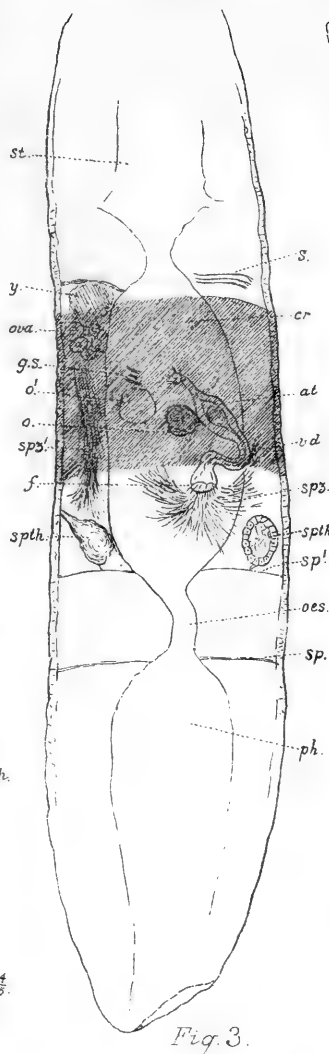


Fig. 3.

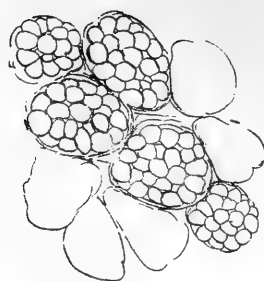


Fig. 2.

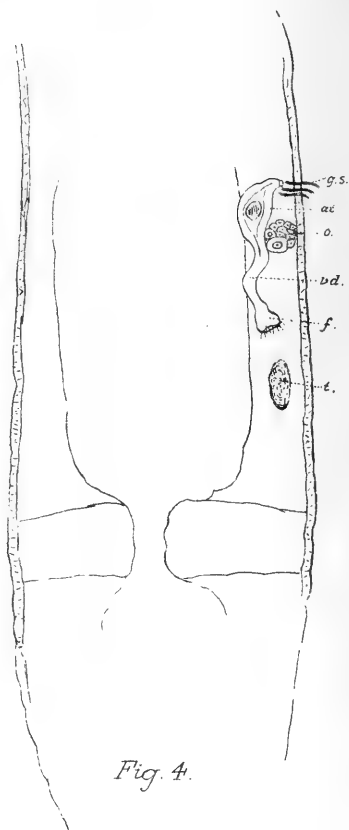


Fig. 4.

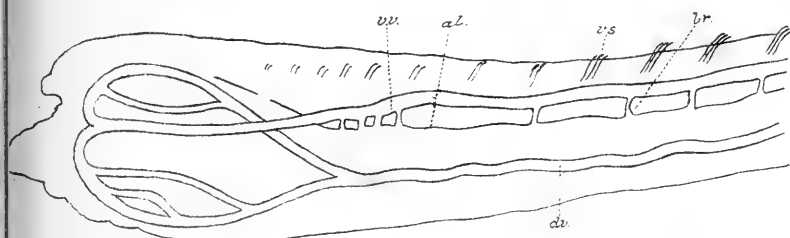


Fig. 7.

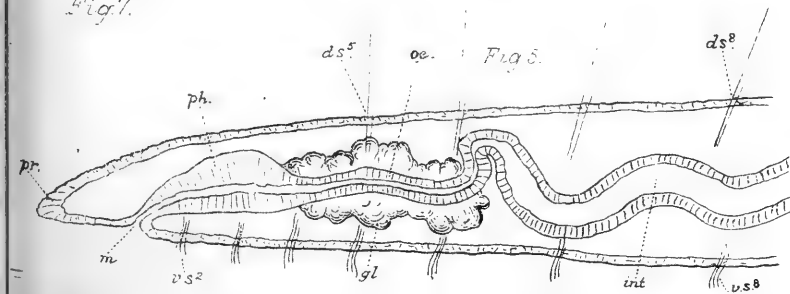


Fig. 8.

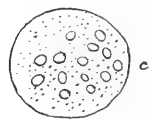


Fig. 6.





VI. AN UNDESCRIBED BURMESE FROG
ALLIED TO *RANA TIGRINA*.

By N. ANNANDALE, D.Sc., F.A.S.B., Superintendent,
Indian Museum.

Mr. I. H. Burkill has recently called my attention to certain frogs eaten in Burma and represented by specimens in the collection of the Reporter on Economic Products to the Government of India. Among these specimens are several that appear to represent a species hitherto confused with *Rana tigrina* and here described as:—

Rana burkilli, sp. nov.

Closely allied to *Rana tigrina*, Boie, from which it may be distinguished by the following characters:—

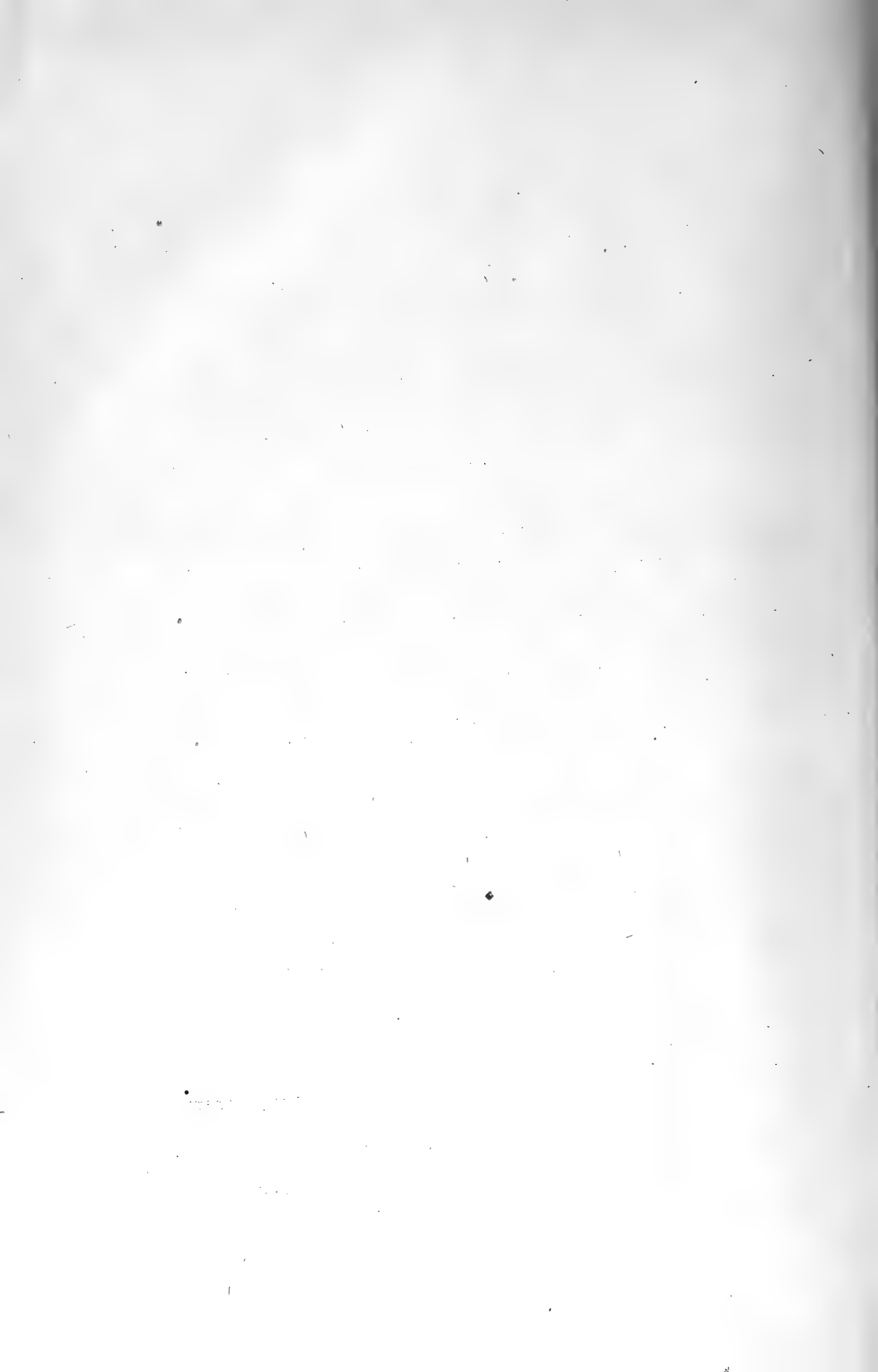
- (1) The snout is much less strongly pointed and does not project so far beyond the mouth, so that the upper jaw when viewed from below appears to be of nearly the same width throughout instead of being distinctly broader in front than at the sides.
- (2) The tibio-tarsal joint falls short of the ear, as a rule by a considerable distance.
- (3) The internal metatarsal tubercle is somewhat feebly developed.
- (4) The skin of the back and the dorsal surface of the thighs is more warty than is usually the case in *R. tigrina*.
- (5) The dorsal surface is of a dull brownish or greyish colour spotted with black, the surface of the longitudinal ridges and the tips of the smaller warts being whitish. The ventral surface is marked with black, the markings sometimes taking on a reticulate character all over the belly. There is no pale dorsal stripe.

Localities.—Mandalay, Upper Burma (J. Anderson, Indian Museum); Tavoy (types); Bassein, Pegu.

Length of type specimen (No. 16569, Indian Museum) 91 mm. without legs.

None of the specimens have vocal sacs, but as most of them have been eviscerated their sex cannot be ascertained.

Mr. Burkill tells me, on the authority of the Burmese, that the new species buries itself in the embankments of rice-fields during the dry weather, while *R. tigrina* remains active throughout the year. The two species occur in the same localities.



MISCELLANEA.

BIRDS.

NOTES ON THE OCCURRENCE OF *Vultur monachus* IN CALCUTTA.—On the 21st of November 1909 an attendant at the Calcutta slaughter-house captured and brought to the Museum alive, an adult male specimen of the Cinereous Vulture (*Vultur monachus*) the prepared skin of which I had the pleasure of inspecting the following month.

This capture very greatly extends the hitherto-recorded range of this fine vulture which is essentially a bird of the extreme north-west of India, straggling along the Himalayas to Bhutan and possibly further east in Tibet. As far as I can ascertain, the only record of *Vultur monachus* ever having occurred south or south-east of the Brahmaputra is my own record of a pair which I found breeding in North Cachar in 1888-89, and from the nest of which I twice took eggs (*Journ. Bomb. Nat. Hist. Soc.*, xi, page 391).

A pair were also seen by me at Dimagiri in Bhutan in November, 1885, and an egg was procured for me by the Bhuteas from a cliff further in the mountains and at a considerably higher elevation.

Throughout the Dooars I have no record of its having been shot, though it must occasionally occur there in the cold weather, and it is not until one gets well into the north-west that it is often met with.

Dr. Annandale has noted the colours of the soft parts of the Calcutta bird as follows: "The bill is blackish brown; the cere pale mauve; the iris brown; the naked skin of the neck livid flesh-colour; the legs and feet creamy or pearly white. The wing from carpal joint to tip of longest primary is 29·10 inches."

E. C. STUART-BAKER,
F.Z.S., F.L.S.

AN ALBINO OWL.—Among the birds recently received at the Indian Museum is an albino specimen of the Spotted Owlet (*Athene brama*) presented by Mr. D. Ezra, who obtained it alive from Benares. The eyes were of a uniform deep violet, and the soft parts showed no signs of pigmentation; the feathers are quite white. The bird was an adult male. The following are its measurements: length 8·5 inches; wing 6·1; tail 3·2; tarsus 1·1; bill ·8.

N. ANNANDALE.

POLYCHÆTE WORMS.

“*Matla bengalensis*”: A CORRECTION.—In a previous number of this Journal (*Rec. Ind. Mus.*, vol. ii, p. 39) I gave a description of a form which I supposed to belong to a new genus of the Naididæ. The animals, discovered in the brackish ponds at Port Canning, showed no sexual organs; but on the other hand asexual reproduction was equally not to be observed.

Last summer, while working at the Millport Marine Biological Station on the west coast of Scotland, I came across countless numbers of *Capitella capitata*; and on examining a number of very young forms, I was surprised to find that they resembled in an extraordinary degree my previous specimens of *Matla*.

By a curious coincidence I received within the following week a letter from Prof. Michaelsen of Hamburg, in which he wrote that, after reading the description of *Matla*, he was of opinion that it was no Oligochæte but a Polychæte belonging to the Capitellidæ.

It is easy to see that the fact that my Port Canning specimens showed no signs of asexual division ought to have put me on my guard. I think there can be no doubt that the worms were very young specimens of a Capitellid, and hence that the name given to them ought now to disappear.

J. STEPHENSON.

VII. DESCRIPTION D'OPHIURES NOU-
VELLES PROVENANT DES DERNIÈRES
CAMPAGNES DE "L'INVESTIGATOR"
DANS L'OCEAN INDIEN.

Par R. KOEHLER, Professeur de Zoologie à l'Université de Lyon.

Avec la Planche V.

Parmi les collections qui ont été recueillies par "l'Investigator" dans l'Océan Indien depuis l'époque où j'ai publié mon mémoire sur les Ophiures de mer profonde¹ et dont M. le Dr. Annandale, Superintendant du Musée de Calcutta, a bien voulu me confier l'étude, j'ai rencontré trois formes nouvelles d'Ophiures de mer profonde. Ces Ophiures appartiennent respectivement aux genres *Ophioglypha*, *Amphiura* et *Astrotoma*. J'en donne ci-dessous la description détaillée.

Ophioglypha podica, sp. nov.

(Fig. 1 et 2.)

Station 355. Lat. N. 21° 49' 54". Long. E. 59° 48'. Profondeur 492 brasses. Trois échantillons.

Le diamètre du disque ne dépasse pas 5.5 à 6 millim. Les bras mesurent 12 à 13 millim. depuis leur insertion sur le disque. Tout l'animal est très délicat et grêle ; les bras sont très minces.

Le disque est pentagonal avec les côtés légèrement arrondis ; il est aplati et les bords sont tranchants. La face dorsale est à peu près plane et la face ventrale est légèrement convexe. La face dorsale offre des plaques assez grandes, inégales et pas très nombreuses. On distingue une rosette centrale comprenant une plaque centrale, grande et arrondie, entourée par cinq plaques radiales qui se touchent par la plus grande partie de leurs bords latéraux. Chaque plaque présente, en son milieu, une petite saillie arrondie plus ou moins marquée. Parmi les autres plaques, on reconnaît, dans chaque espace interr radial, généralement deux plaques plus grandes que les autres, l'interne moins développée, mais l'externe beaucoup plus grande et placée à la périphérie du disque : cette dernière a la forme d'un triangle à bords arrondis et son côté libre occupe presque toute la périphérie du disque entre les boucliers radiaux. Ceux-ci sont très grands,

¹ "Ophiures recueillies dans l'Océan Indien : I.—Les Ophiures de mer profonde," *Echinoderma of the Indian Museum*, Calcutta, 1899.

triangulaires, contigus sur plus de la moitié de leur longueur et séparés en dedans par une petite plaque triangulaire. En dehors d'eux se montrent quelques papilles radiales basses et obtuses, qui forment un petit peigne se continuant sans aucune interruption avec son congénère de l'autre côté, au dessus de la base de chaque bras comme dans les *O. scutata* et *clemens*. Lorsqu'on regarde l'Ophiure par en haut, on compte environ cinq papilles de chaque côté, soit en tout une dizaine à la base de chaque bras. Ces papilles ne se continuent pas sur la fente génitale et elles disparaissent sur la face ventrale du corps.

La face ventrale du disque est couverte de plaques peu nombreuses, polygonales ou arrondies, et légèrement imbriquées. Celles qui avoisinent le bord du disque sont plus régulières et plus grandes, et elles sont souvent au nombre de trois ou de quatre dans chaque espace interradiat. Les fentes génitales sont de moyennes dimensions.

Les boucliers buccaux ont une forme caractéristique. Ils sont petits et étroits, mais assez épais de telle sorte qu'ils forment une saillie assez marquée. Ils sont presque deux fois plus longs que larges, avec un angle proximal et un bord distal fortement convexe. Les bords latéraux sont légèrement échancrés en leur milieu au point qui correspond au fond de la fente génitale. Les plaques adorales sont étroites et petites, rétrécies en dehors. Les plaques orales sont de dimensions moyennes, triangulaires et un peu allongées. Les papilles buccales sont au nombre de cinq ou six : les plus externes sont fines et pointues, puis elles deviennent un peu plus fortes et la plus interne est allongée, ainsi que la papille impaire qu'elle avoisine.

Les plaques brachiales dorsales sont très petites, triangulaires et très largement séparées ; elles sont un peu plus larges que longues, avec un angle proximal obtus et un bord distal à peu près droit.

La première plaque brachiale ventrale est relativement grande, triangulaire, avec un angle proximal aigu et un bord distal un peu arrondi. Les deux suivantes sont pentagonales, courtes et très élargies, presque trois fois plus larges que longues, avec un angle proximal très obtus et arrondi, à peine marqué, deux bords latéraux droits et un côté distal à peu près droit. Les suivantes deviennent triangulaires, avec un bord distal arrondi. Elles sont très largement séparées.

Les plaques latérales portent trois piquants cylindriques et pointus, égalant le tiers de l'article. Ils sont rapprochés l'un de l'autre et plus voisins de la face ventrale de la plaque.

Les pores tentaculaires de la première paire sont grands et ils s'ouvrent dans la bouche : ils portent en général, sur chaque bord, quatre écailles obtuses et assez grandes. Les pores de la deuxième paire, encore grands, offrent trois ou quatre écailles externes et trois internes. Ceux de la troisième paire ont trois écailles externes et deux internes. Enfin les pores de la quatrième paire ont une ou deux écailles externes et proximales et

une écaille distale. Au delà, les pores ne portent plus qu'une seule écaille proximale.

Rapports et différences.—L' *O. podica* ne peut guère être rapprochée que de l' *O. scutata*, Lyman, qu'elle rappelle par les papilles radiales formant, en dehors des boucliers radiaux, une bordure continue à la base du bras, mais elle diffère de cette espèce par les plaques dorsales et ventrales du disque plus nombreuses, par les boucliers radiaux plus grands, par la forme des boucliers buccaux, par les piquants brachiaux plus allongés, etc. La disposition des papilles radiales rappelle aussi celle que j'ai indiquée chez l' *O. clemens*, mais les deux espèces sont complètement différentes.

Amphiura famula, sp. nov.

(Fig. 3 et 4.)

Station 372. Lat. N. 13° 54' 15". Long. E. 94° 02' 15". Profondeur 643 brasses. Deux échantillons, dont l'un est très petit.

Dans le grand individu, le diamètre du disque est de 9 millim. ; les bras sont incomplets, mais ils devaient être très longs et atteindre 9 ou 10 cent. de longueur. Dans le petit exemplaire, le diamètre du disque est de 4 millim. et les bras sont également très longs : je ne puis en mesurer la longueur exacte car ils sont très sinueux, mais ils doivent avoir environ 35 à 40 millim.

Le disque est pentagonal, légèrement excavé dans les espaces interradiaux. La face dorsale du grand échantillon est couverte de plaques nombreuses, de forme irrégulière et inégales, un peu imbriquées. La région centrale présente quelques plaques un peu plus grandes que les voisines, mais il n'y a pas la moindre indication de plaques primaires. Au contraire, dans le petit individu, on peut voir une rosette de grandes plaques distinctes. A la périphérie du disque, les plaques deviennent brusquement beaucoup plus petites et identiques à celles de la face ventrale : elles forment ainsi une bordure très apparente, bien qu' étroite. Les boucliers radiaux sont petits, triangulaires, avec le bord extérieur convexe ; ils sont presque contigus en dehors et légèrement divergents en dedans où ils sont séparés par une, puis par deux plaques. Leur longueur est égale au tiers du rayon du disque.

La face ventrale du disque est uniformément couverte de plaques très petites, non imbriquées, assez épaisses et saillantes. Les fentes génitales sont étroites.

Les boucliers buccaux sont petits, plus longs que larges et piriformes : le lobe externe qu'ils forment est plus ou moins proéminent dans l'espace interr radial. Les plaques adorales, de moyenne grosseur, offrent un bord interne concave et suivant la courbure du bouclier buccal ; elles sont très élargies en dehors, tandis qu'elles sont très étroites en dedans et se touchent à peine. Les plaques orales sont petites, courtes et épaisses. Les papilles buccales sont au nombre de quatre : l'externe est assez grande,

squamiforme et arrondie, les deux suivantes sont petites, coniques et pointues, la dernière est un peu plus épaisse, conique, mais peu développée.

Les plaques brachiales dorsales sont presque trois fois plus larges que longues. Elles sont presque biconvexes: cependant le bord proximal est ordinairement décomposé en deux côtés se reliant par un angle très obtus et arrondi; elles sont toutes contiguës. Au commencement du bras, elles offrent en leur milieu une petite empreinte circulaire peu marquée.

La première plaque brachiale ventrale est très petite, triangulaire ou trapézoïdale. Les suivantes sont grandes, quadrangulaires, avec un bord distal très grand, presque droit en son milieu et se recourbant vers ses extrémités pour rejoindre les bords latéraux qui sont obliques et assez fortement excavés par l'écaille tentaculaire correspondante; le côté proximal est étroit et droit. Les quatre angles de ces plaques, ainsi que le milieu du côté distal, sont légèrement saillants. Elles sont toutes contiguës.

Les plaques latérales sont peu développées. Elles portent chacune trois piquants subégaux égalant à peu près l'article: le piquant dorsal et le piquant ventral sont coniques et pointus; le piquant médian est plus large, plus fort et un peu plus long que les autres et son extrémité est arrondie.

Les écailles tentaculaires, au nombre de deux, sont assez grandes. L'interne, un peu plus forte que l'autre, est couchée le long du bord externe de la plaque brachiale ventrale; elle est ovale et un peu plus longue que large. L'écaille externe est placée obliquement par rapport à la précédente: elle est à peu près aussi longue que large.

Rapports et différences.—L' *A. jamula* appartient à la section *Amphioplus*. Elle se distingue facilement de toutes les espèces de cette section ayant deux écailles tentaculaires et trois piquants brachiaux par la différence de taille et de forme très marquée entre les plaques dorsales et ventrales du disque, par les plaques ventrales très petites mais cependant épaisses et saillantes, par la papille buccale externe élargie tandis que les trois autres sont petites, par la forme des plaques brachiales ventrales et par le piquant médian plus gros. On peut la rapprocher des *A. præstans*, Koehler, et *intermedia*, Koehler, mais elle se distingue de ces deux espèces par les caractères que je viens d'énumérer.

Astrotoma rigens, sp. nov.

(Fig. 5, 6, 7 et 8.)

Station 355. Lat. N. 21° 49' 54". Long. E. 59° 48'. Profondeur 492 brasses. Douze échantillons.

Dans les plus grands individus, le diamètre du disque arrive à 10 millim.; les bras, très circonvolutionnés, atteignent environ 50 à 60 millim. de longueur. Les téguments sont résistants et durs; les bras sont rigides et cassants.

Le disque est arrondi, assez épais et il offre, sur sa face dorsale, dix côtes radiales saillantes et très larges ; il est déprimé dans la région centrale et renflé au contraire vers l'extrémité des côtes radiales, au dessus de l'insertion des bras qui se trouve sur un plan un peu inférieur à celui du disque. Il est plus ou moins excavé dans les espaces interradiaux et il offre également une petite courbe concave entre les extrémités des boucliers radiaux de chaque paire.

La face dorsale du disque est recouverte de granules inégaux, les plus gros arrondis et les autres se relevant en petits cônes émoussés ; vers la périphérie du disque, ces granules sont un peu plus hauts et plus pointus que dans la partie centrale.

La face ventrale du disque, entre les fentes génitales, est fortement rétrécie en dedans en raison de l'extrême largeur de ces fentes. Les granules y sont moins développés et plus aplatis que sur la face dorsale, mais, vers la périphérie et le long des fentes génitales, ils sont coniques et pointus. Sur la partie proximale de chaque espace interradiel, entre les bases des bras, on remarque un groupe de granules très développés, allongés et coniques, et qui mériteraient même le nom de piquants : ils sont disposés plus ou moins régulièrement sur trois rangs. Un autre groupe de piquants se montre vers le sommet de chaque angle buccal, formant ainsi des papilles dentaires bien développées, un peu plus épaisses et plus courtes que les dents qui sont fines et allongées. Les autres parties de la face ventrale sont recouvertes de granules aplatis, contigus et un peu inégaux. Ceux-ci se continuent sur la face ventrale des bras.

Les fentes génitales sont extrêmement développées et très larges ; elles sont ovalaires et mesurent environ 1 millim. sur 3.

Les bras, très nettement séparés du disque à leur insertion, sont minces, grêles, rigides et très circonvolutionnés. Leur largeur à la base est de 2 millim. dans un exemplaire dont le disque a 10 millim. de diamètre. Ils s'amincissent très lentement jusqu'à l'extrémité qui est toujours enroulée sur elle même. La hauteur est un peu inférieure à la largeur. Les articles successifs sont peu nettement indiqués à la face dorsale par des parties alternativement un peu saillantes et un peu déprimées. Ces dernières sont recouvertes de granules disposés sur deux ou trois rangées plus ou moins distinctes : les granules, d'abord identiques à ceux de la face dorsale du disque, deviennent progressivement plus fins et plus réguliers. Les parties saillantes portent de petits crochets recourbés qui se développent et deviennent plus nombreux sur les faces latérales du bras au dessus de l'insertion des écailles tentaculaires.

Les pores tentaculaires de la première paire sont petits et dépourvus d'écailles. Les pores de la deuxième paire sont armés de trois et parfois même de quatre piquants extrêmement développés, allongés, cylindriques et épais, légèrement élargis à l'extrémité qui offre de petits lobes ou spinules obtuses : leur longueur dépasse celle de l'article. Les pores de la troisième paire

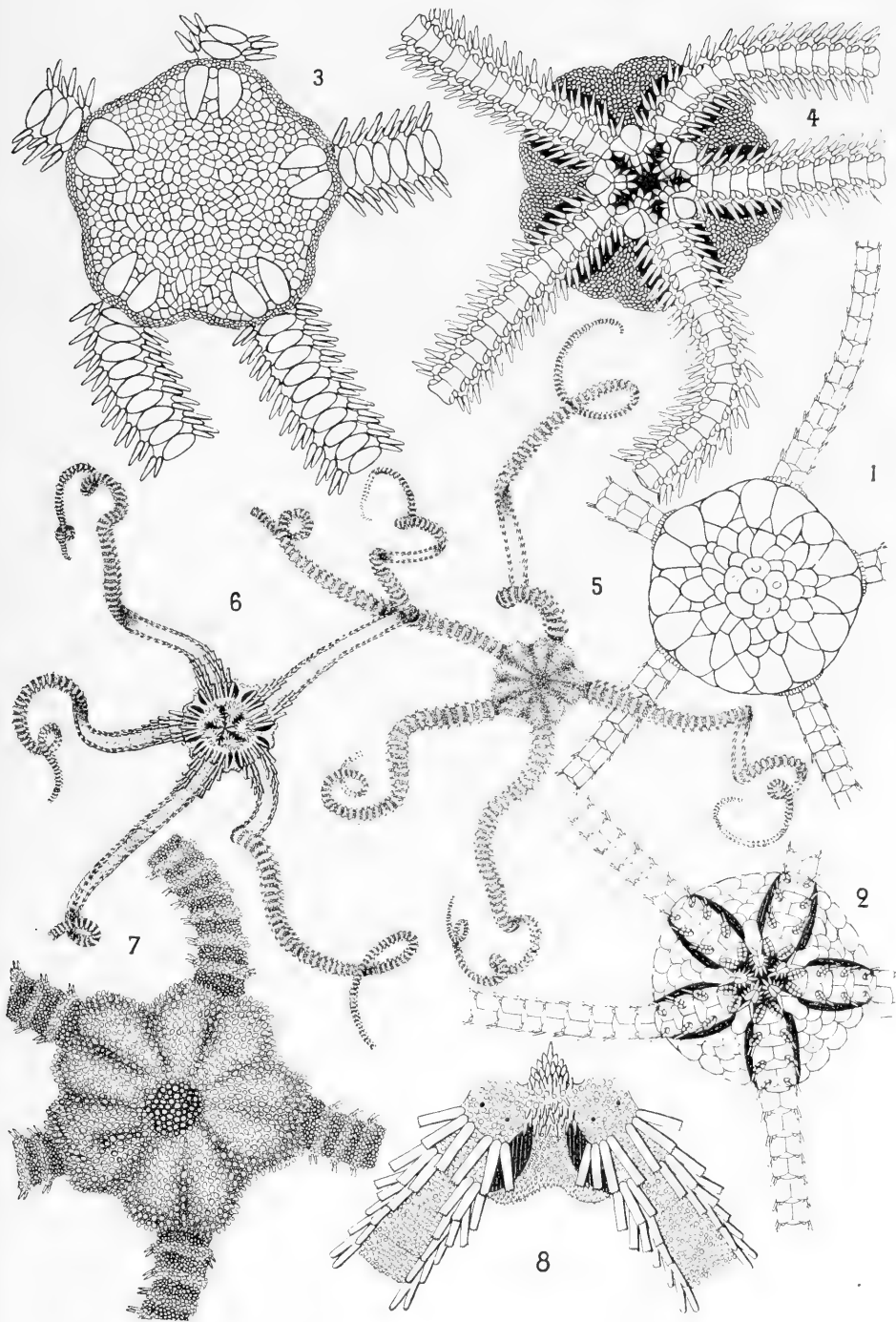
sont munis de trois piquants à peu près identiques aux précédents, mais la longueur et la grosseur des trois piquants diminuent notablement sur la paire suivante. A partir de la cinquième paire, il n'existe plus que deux piquants d'abord assez forts, élargis à la base ainsi qu'à l'extrémité qui est obtuse et garnie de quelques spinules, puis la taille diminue progressivement. Le piquant externe est un peu plus court que l'interne.

La plupart des individus offrent une coloration jaune; quelques-uns sont blancs.

Rapports et différences.—Le genre *Astrotoma* est actuellement représenté par quatre espèces; trois proviennent de l'Océan Indien: ce sont les *A. murrayi*, Lyman, *bellator*, Koehler, et *vecors*, Koehler; la quatrième espèce, l'*A. agassizi*, Lyman, est connue au Chili et dans le détroit de Magellan. La nouvelle espèce découverte par "l'Investigator" est plus voisine de l'*A. vecors* que des autres, mais elle s'éloigne de toutes par le grand développement des piquants que portent les pores tentaculaires de la deuxième et de la troisième paires: ces piquants sont au nombre de trois au moins, ainsi que sur la paire suivante; ce chiffre tombe à deux sur les autres articles.

EXPLICATION DE LA PLANCHE V.

- FIG. 1.—*Ophioglypha podica*. Face dorsale.
FIG. 2.—*Ophioglypha podica*. Face ventrale.
FIG. 3.—*Amphiura famula*. Face dorsale.
FIG. 4.—*Amphiura famula*. Face ventrale.
FIG. 5.—*Astrotoma rigens*. Individu entier vu par la face dorsale.
FIG. 6.—*Astrotoma rigens*. Individu entier vu par la face ventrale.
FIG. 7.—*Astrotoma rigens*. Face dorsale du disque.
FIG. 8.—*Astrotoma rigens*. Face ventrale du disque.



VIII. DESCRIPTION D'HOLOTHURIES NOUVELLES APPARTENANT AU MUSÉE INDIEN.

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C. VANEY, Maître de conférences à l'Université de Lyon.

Parmi les Holothuries recueillies dans les mers de l'Inde depuis la publication de nos deux mémoires sur les Holothuries de l'Investigator,¹ et que Monsieur le Dr. Annandale, Superintendant du Musée de Calcutta, a bien voulu nous confier, nous avons trouvé, à côté de types déjà connus, un certain nombre d'espèces nouvelles dont nous donnons la description dans ce travail. Ces formes nouvelles sont au nombre de neuf et elles se répartissent en familles de la manière suivante :

SYNALLACTIDÉS.

Synallactes anceps.

Bathyplores cinctus.

Bathyplores roseus.

Pelopates dissidens.

• ELPIDIIDÉS.

Enypniastes (?) decipiens.

CUCUMARIIDÉS.

Cucumaria digitata.

Cucumaria imbellis.

Cucumaria mosaïca.

Cucumaria perdita.

Les espèces déjà connues étaient au nombre de douze dans la collection qui nous a été remise. Ces Holothuries ne donnent en général pas lieu à des remarques spéciales ; nous nous contenterons, à la fin de notre travail, d'en fournir la liste avec l'indication des localités et des profondeurs, ces données pouvant offrir quelque intérêt au point de vue de la répartition des espèces.

¹ " Holothuries recueillies par l' ' Investigator ' dans l'Océan Indien. " —

(1) Les Holothuries de mer profonde. Calcutta, 1905.

(2) Les Holothuries littorales. Calcutta, 1908.

SYNALLACTIDÉS.

Synallactes anceps, sp. nov.

(Pl. ii, fig. 6—10.)

Station 319. Lat. N. 12° 02'. Long. E. 73° 46'. Profondeur 1,154 brasses. Un échantillon.

L'exemplaire n'est pas en très bon état de conservation, mais il présente certains caractères si particuliers que nous n'hésitons pas à en faire le type d'une espèce nouvelle.

Le corps est ovale, avec la face ventrale aplatie et la face dorsale convexe; il a 55 mm. de longueur et 20 mm. dans sa plus grande largeur. Sur la face ventrale (pl. ii, fig. 6), nous observons, en arrière du cercle des tentacules, une forte constriction transversale séparant ainsi la région céphalique du reste du corps; cette constriction ne se continue pas sur la face dorsale (pl. ii, fig. 7). La bouche, ventrale, est entourée de dix-huit tentacules courts, dont le disque, étalé, présente de nombreuses papilles; l'anus est dorsal mais presque terminal. La sole ventrale offre un grand nombre de pédicelles qui semblent localisés en grande partie sur les radius. Les pédicelles du radius médian sont plus petits que ceux des radius latéraux; ils sont placés au fond d'une dépression médiane et se montrent sur toute la longueur du corps; dans la région postérieure, ces pédicelles du radius médian sont en plus grand nombre que dans la région antérieure, et, en arrière, certains d'entre eux forment de chaque côté une rangée de cinq à six appendices.

Sur les radius latéro-ventraux, les pédicelles forment quatre ou six rangées irrégulières, dont quelques-unes se retrouvent du côté dorsal. La face dorsale est très fortement plissée et endommagée; elle semble présenter sur chaque radius dorsal une double rangée de grandes papilles effilées pouvant atteindre 10 mm. de longueur (fig. 7).

Les téguments sont d'un blanc jaunâtre et ils renferment de nombreux corpuscules dont les tiges saillantes hérissent toute la surface du corps. Ils consistent exclusivement en corpuscules turriformes dont la base, (pl. ii, fig. 8), est constituée par quatre bras grêles et qui se terminent en un disque élargi pourvu de quelques perforations; la tourelle (pl. ii, fig. 9) se réduit à une tige centrale conique présentant de distance en distance quelques piquants.

Les pédicelles ventraux renferment des bâtonnets arqués munis de quelques pointes à leurs extrémités (pl. ii, fig. 10).

L'exemplaire est éviscéré; une portion d'organe arborescent fait saillie par l'ouverture anale. Les organes génitaux sont composés d'une houppe de tubes jaunâtres plus ou moins ramifiés et atteignant le milieu du corps. L'anneau calcaire fait complètement défaut.

Rapports et différences.—La répartition des appendices ambulatoires sur tous les radius, l'absence de bordure marginale et la

présence de corpuscules cruciformes à tige centrale simple, nous permettent de ranger notre Holothurie dans le genre *Synallactes*. Le *S. anceps* se distingue des autres espèces connues par la différence de grosseur entre les pédicelles ventraux : les pédicelles médians sont de petite taille et les pédicelles latéro-ventraux sont beaucoup plus gros.

Bathyplores cinctus, sp. nov.

(Pl. i, fig. 1--10.)

Station 332. Lat. N. $10^{\circ} 21'$. Long. E. $92^{\circ} 46\frac{1}{4}'$. Profondeur 279 brasses. Un échantillon.

Le corps est ovale et aplati; sa couleur est blanc-jaunâtre. Il mesure 80 mm. de longueur et 22 mm. de largeur. La bouche est ventrale et l'anus dorsal. Le long de la ligne médiane ventrale, on remarque une dépression qui s'étend de l'anus jusqu'à la région buccale (pl. i, fig. 1); de part et d'autre de cette dépression médiane se trouvent deux rangées longitudinales de pédicelles, plus ou moins irrégulièrement disséminés. Les parties latérales de la sole ventrale offrent une nouvelle série ambulacraire formée de deux ou trois rangées longitudinales, plus ou moins bien définies, de pédicelles plus gros que les médians; entre les rangées marginales et l'aire ambulacraire centrale, se trouve toute une région presque complètement dépourvue de pédicelles; cette région est bien nette dans la partie postérieure du corps, mais peu distincte dans la partie antérieure où elle renferme quelques appendices. Le bord de la sole ventrale présente quelques grosses papilles, à base élargie et plus ou moins contiguës; ces papilles forment, par leur ensemble, une bordure latérale. En avant, cette bordure se prolonge en une collerette péribuccale formée par une vingtaine de lobes munis d'une papille médiane.

Sur la face dorsale, se trouvent disséminées de grosses papilles, dont la base élargie mesure 2 mm. de diamètre; chacune d'elles est surmontée d'un mamelon dont la longueur peut atteindre 2 mm. Quoiqu'il en soit la répartition de ces papilles dorsales semble irrégulière, on peut en compter en moyenne six dans le sens transversal.

Les téguments sont épais, blanchâtres, de consistance gélatineuse; ils renferment de nombreux corpuscules calcaires.

Sur la face dorsale, on trouve des corpuscules turriformes à base tétraradiée (pl. i, fig. 2 *a* et *b* et fig. 3 *b*) dont chaque branche s'étale à son extrémité distale en un disque aplati présentant plusieurs ouvertures; la tourelle centrale (pl. i, fig. 6 *a* et *b*, et fig. 3 *a*) est formée par quatre piliers verticaux, légèrement convergents à leur sommet, qui porte quelques piquants; ces piliers sont réunis les uns aux autres par trois ou quatre étages de travées transversales. Dans les papilles dorsales, ces tourelles (pl. i, fig. 8) sont plus élancées, leurs travées sont plus rapprochées du sommet, leur base est constituée par des bras plus courts, enfin le disque terminal, peu élargi, n'offre qu'une ouverture centrale; on retrouve de semblables tourelles dans les téguments ventraux, mais ici

les disques terminaux des bras de la base sont réunis les uns aux autres par des arcs périphériques (pl. i, fig. 5). Enfin l'on rencontre aussi quelques corpuscules en C (pl. i, fig. 7). Les pédicelles ventraux renferment des bâtonnets faiblement arqués et munis de quelques pointes, soit à leurs extrémités, soit le long de leurs bords (pl. i, fig. 10); les papilles dorsales renferment des bâtonnets semblables mais pourvus d'un plus grand nombre de piquants (pl. i, fig. 9). L'anneau calcaire est constitué par dix pièces; les interradiales sont en forme d'accent circonflexe; quant aux radiales, elles sont plus massives, échancrées en avant et elles se prolongent en arrière par deux courtes pointes (pl. i, fig. 4). La vésicule de Poli, unique, a 12 mm. de longueur.

Rapports et différences.—Le *Bathyplores cinctus* se rapproche du *B. assimilis* par la forme des corpuscules calcaires (tourelles et bâtonnets), par la présence de grandes papilles dorsales et de nombreux pédicelles de chaque côté de la gouttière médiane ventrale; mais il s'en sépare nettement par la disposition des pédicelles de la sole ventrale et par la présence de corpuscules en C.

Le *B. cinctus* se rapproche du *B. patagiatus* Fisher,¹ par les corpuscules de la paroi dorsale et de la paroi ventrale, ainsi que par ceux des papilles et des pédicelles; mais, dans l'espèce des îles Hawaï, la répartition des appendices ambulacraires est bien différente; en effet, Fisher indique seulement une simple série, quelque fois irrégulière, de nombreux petits pédicelles le long de chaque ambulacre latéro-ventral, et, immédiatement au dessus de ceux-ci sur le bord du corps, une autre série de nombreuses petites excroissances verruqueuses formant bordure et se terminant chacune par une papille grêle.

Bathyplores roseus, sp. nov.

(Pl. i, fig. 11—17.)

Station 279. Lat. N. 11° 35' 15". Long. E. 80° 02' 15". Profondeur 300 brasses. Deux échantillons.

Station 280. Lat. N. 11° 29' 45". Long. E. 80° 02' 30". Profondeur 446 brasses. Trois échantillons.

Tous les exemplaires sont en mauvais état; ils sont déformés et les téguments sont en partie arrachés. Ils ont tous une coloration rose. Le corps est large et aplati; sa longueur est comprise entre 110 et 150 mm. et la largeur varie de 40 à 50 mm. La face ventrale, aplatie, forme une sole limitée par une bordure marginale (pl. i, fig. 11); la face dorsale est convexe et présente de nombreuses papilles. La bouche, ventrale, est située à 10 ou 15 mm. en arrière du bord antérieur; l'anus, dorsal, s'ouvre à 10 mm. du bord postérieur et il est entouré par quelques grosses papilles. Le long du radius médian ventral court une gouttière qui s'étend de

¹ 1907. W. K. Fisher, "The Holothurians of the Hawaiian Islands," p. 688, pl. lxxii, figs 1, a—k: *Proceedings of the United States National Museum*, vol. xxxii.

la bouche à l'anus et dans la région postérieure de laquelle on distingue une dizaine de petits appendices disposés sur deux rangées plus ou moins alternantes (fig. 11). Parfois l'on retrouve encore, en avant de cette région, quelques petits pédicelles éloignés les uns des autres; toutefois, dans l'un des exemplaires, ces pédicelles médians ventraux semblent faire complètement défaut. De part et d'autre de la gouttière sont disposés de nombreux pédicelles, dont quelques-uns forment une ou deux rangées presque contiguës à la dépression et dont les autres sont disposés vers le rebord marginal en quatre ou cinq rangées; ces deux groupes se réunissent, soit vers leur région postérieure où ils forment des appendices de plus petite taille, soit vers la région médiane du corps, grâce à un certain nombre de pédicelles plus ou moins irrégulièrement disséminés.

La bordure marginale, qui entoure tout le pourtour de la soie ventrale, se décompose en trois régions: d'abord une collerette péribuccale formée par une quarantaine de lobes à contour arrondi, puis par une bordure marginale formée, elle aussi, d'une quarantaine d'appendices à base élargie, bien séparés les uns des autres dans la région antérieure mais se soudant ensuite par leurs bases: l'ensemble constitue ainsi une bordure festonnée dont chaque lobe est parfois surmonté par une petite papille. Enfin, à la suite de cette bordure latérale, vient une collerette terminale à contour ovalaire, formée par treize paires de lobes dont quelques-uns sont surmontés d'une papille très grêle.

La face dorsale présente, à une certaine distance du bord, de nombreuses papilles irrégulièrement disséminées et à base élargie.

Les téguments ont une consistance gélatineuse; ils sont mous et épais, et, chez quelques exemplaires, les corpuscules calcaires ont été attaqués ou même complètement dissous par les liquides conservateurs.

Dans la paroi du corps, les corpuscules, très nombreux, comprennent surtout de petits corpuscules turriiformes à base tétra-radiée (pl. i, fig. 14); au centre de la base s'élèvent quatre courts piliers réunis l'un à l'autre par un ou deux étages de travées transversales; le sommet des tourelles est couronné par quelques grands piquants. Les bras de la base s'élargissent à leur extrémité périphérique et cette partie élargie présente une ou deux grandes ouvertures. Entre ces tourelles, on distingue quelques corpuscules en C (pl. i, fig. 16).

Les papilles dorsales renferment des corpuscules turriiformes (pl. i, fig. 13 *a* et *b*) et des bâtonnets arqués (pl. i, fig. 15) dont l'extrémité est munie de quelques petits piquants. Les pédicelles ventraux renferment une plaque terminale, quelques corpuscules turriiformes, des corpuscules en C et surtout de forts bâtonnets à surface un peu rugueuse. Ces bâtonnets sont tantôt simples (pl. i, fig. 12*c*) tantôt plus ou moins ramifiés (pl. i, fig. 12 *a* et *b*).

Les échantillons sont totalement éviscérés et par conséquent nous ne pouvons donner aucun renseignement sur l'organisation

interne. L'anneau calcaire paraît faire complètement défaut. Les bandes musculaires ont près de 10 mm. de largeur et leur coloration est marron.

Rapports et différences.—Le *B. roseus* offre, comme le *B. phlegmaticus* Sluiter, et le *B. natans* (Sars), des pédicelles dans la région postérieure du radius médian ventral; mais, ainsi que cela arrive dans cette dernière espèce, ces pédicelles médians ventraux peuvent faire défaut.

Le *B. roseus* se distingue du *B. natans* par ses papilles irrégulièrement disposées et par la forme de ses corpuscules calcaires; c'est aussi par la forme de ces derniers qu'il se distingue du *B. phlegmaticus*.

La disposition des pédicelles ventraux du *B. roseus* rappelle celle que nous avons décrite chez notre *B. cinctus*: mais ces deux espèces diffèrent entre elles par leur bordure marginale, par la disposition et le nombre des papilles dorsales et par la forme des corpuscules calcaires. Les corpuscules du *B. roseus* rappellent aussi ceux du *B. assimilis* Koehler et Vaney; mais la répartition des pédicelles ventraux et la structure de la bordure marginale est bien différente dans les deux espèces.

Pelopatides dissidens, sp. nov.

(Pl. iii, fig. 10.)

Station 315. Lat N. 10° 6'. Long. E. 92° 29'. Profondeur 705 brasses. Un échantillon.

Le corps est aplati; la face ventrale et la face dorsale sont légèrement convexes. On remarque sur le pourtour du corps une bordure très développée atteignant parfois 10 mm. de largeur; la région antérieure offre un contour arrondi et la région postérieure se termine en une pointe arrondie. L'exemplaire mesure 110 mm. de longueur et 35 mm. de largeur. L'anus est dorsal et s'ouvre au sommet d'une légère proéminence; il n'est pas terminal car il précède immédiatement la bordure dont nous venons de parler et qui a 7 mm. de largeur à ce niveau.

La bouche, ventrale, est située à 10 mm. en arrière du bord antérieur; elle est entourée par un cercle de 20 (?) tentacules courts et massifs dont la partie distale présente trois à quatre mamelons très saillants.

Les pédicelles sont localisés sur le radius médian ventral (pl. iii, fig. 10); ils sont au nombre de trente-six et disposés sur toute la longueur du radius en deux rangées plus ou moins alternes; un des pédicelles postérieurs se trouve placé en dehors de l'alignement. Ces appendices, quoique rétractés, sont très apparents et très gros et leur diamètre atteint 4 mm.

La bordure marginale a un contour festonné: elle est formée par la soudure d'appendices latéro-ventraux, mais elle n'offre aucune trace de pédicelles.

L'exemplaire est éviscéré et il ne présente ni vésicule de Poli, ni anneau calcaire. Les muscles longitudinaux sont très larges et

de couleur marron. Il reste un organe arborescent s'étendant très en avant dans la cavité générale; il est d'un noir violacé et offre de nombreuses ramifications latérales.

Rapports et différences.—Malgré l'absence de corpuscules calcaires, nous considérons ce *Pelopatides* comme nouveau. Il appartient au groupe des *Pelopatides* dont le radius médian ventral offre des pédicelles sur les deux tiers postérieurs.¹

Il se rapproche du *P. confundens* Théel, par sa bordure à contour festonné, mais il s'en éloigne par la forme du corps, par l'absence de papilles dorsales et par le très grand développement des pédicelles médians ventraux.

Le *P. dissidens* se distingue du *P. gelatinosus* (Walsh) et du *P. mollis* Koehler et Vaney, par la forme de la bordure latérale et par l'absence d'appendices dorsaux.

ELPIDIIDÉS.

Enypniastes (?) *decipiens*, sp. nov.

(Pl. iii, fig. 1.)

Station 322. Lat. N. 11° 26' 30''. Long. E. 92° 53' 45''. Profondeur 378 brasses. Un échantillon.

L'exemplaire est en mauvais état de conservation: un grand nombre de tentacules et de pédicelles sont enlevés et les téguments sont en partie pelés.

Le corps présente une face ventrale aplatie qui se prolonge, en avant, par un voile très développé (pl. iii, fig. 1); la face dorsale est convexe et fortement plissée transversalement. Le corps proprement dit est blanchâtre, le voile est violacé, les pédicelles et les tentacules sont d'un noir violacé.

Le voile fait tout autour du cercle tentaculaire une saillie très forte, qui peut atteindre, en avant, près de 40 mm. Il se compose de trois parties: une médiane formée de quatre à cinq papilles soudées entre elles en une membrane à bord festonné et deux latérales constituées chacune par quatre à six papilles dont le bord libre présente parfois des digitations assez marquées. Les portions latérales se soudent à la partie médiane par leur région distale seulement: le voile présente ainsi une paire d'ouvertures latérales.

La bouche est ventrale. Elle est entourée par un cercle de vingt (?) tentacules, en majeure partie détruits et de couleur noir-violacé. En arrière du cercle tentaculaire, la face ventrale présente une rangée marginale d'une vingtaine de pédicelles noir-violacé, qui se continue sur tout le pourtour de la sole en ne s'interrompant

¹ C'est par suite d'une erreur d'impression que nous avons classé le *P. mammillatus* dans cette catégorie (*Holothuries recueillies par l' "Investigator" dans l'Océan Indien*: Les *Holothuries* de mer profonde, p. 30). Cette espèce, comme d'ailleurs nous l'indiquons à la suite de sa description, appartient bien aux formes de *Pelopatides* dont les pédicelles restent localisés dans le tiers postérieur du corps.

qu'au niveau de l'anus. Les pédicelles postérieurs sont très rapprochés les uns des autres et de plus petite taille que les pédicelles antérieurs. L'anus est terminal et largement ouvert. La face dorsale est fortement plissée et les téguments sont en partie arrachés; en arrière du voile, nous ne trouvons pas trace d'appendices dorsaux.

Les corpuscules calcaires font défaut. Le tube digestif ne présente qu'une seule courbure peu marquée.

Rapports et différences.—La présence de vingt tentacules rapproche cette espèce de l'*Enypniastes eximia* Théel, et de notre *Euriplastes obscura*. Nous pensons que, jusqu'à nouvel ordre, notre Holothurie doit plutôt rentrer dans le genre *Enypniastes* que dans notre genre *Euriplastes*, car le corps est aplati et son voile s'étend en avant dans le prolongement du plan ventral. D'autre part, notre espèce se distingue de l'*E. eximia* par la forme du voile qui est tout-à-fait caractéristique; l'*Enypniastes* (?) *decipiens* ne semble pas non plus avoir de papilles dorsales.

CUCUMARIIDÉS.

Cucumaria digitata, sp. nov.

(Pl. ii, fig. 11—17.)

Station 355. Lat. N. 21° 49' 50". Long. E. 59° 48'. Profondeur 492 brasses. Quatre échantillons.

L'aspect extérieur des exemplaires est très variable: le plus grand, qui a 35 mm. de longueur, est recourbé en forme d'U, avec la branche buccale plus courte que la branche anale (pl. ii, fig. 16); il rappelle ainsi la *Cucumaria incurvata* R. Perrier; les autres individus, dont la longueur varie de dix à quinze millimètres, ne présentent qu'une faible incurvation et leur bouche est tantôt dorsale, tantôt terminale (pl. ii, fig. 17). La couleur des quatre exemplaires est d'un gris noirâtre.

Les pédicelles sont toujours localisés sur les radius, mais leur mode de répartition est aussi très variable. Les radius du bivium en renferment toujours un nombre beaucoup moins grand que les radius du trivium; sur les radius dorsaux, les pédicelles, assez écartés les uns des autres, sont disposés en une seule rangée, qui est continue dans la région postérieure du corps; sur les radius du trivium, ces appendices sont inégalement répartis sur deux rangées, l'une des rangées étant toujours prépondérante. Il y a donc une tendance à la disposition connue dans l'ancien genre *Ocnus*.

Les tentacules, au nombre de dix-huit (?), sont de simples tubes coniques de 2 mm. de longueur et ils ne fournissent aucune ramification latérale.

Le tégument paraît couvert d'écailles; cet aspect tient à la présence de nombreuses plaques plus ou moins imbriquées, disposées en deux couches superposées; dans la couche superficielle, les plaques ont des travées plus grêles que dans la série profonde.

Ces plaques (pl. ii, fig. 13), circulaires, présentent un grand nombre de perforations; leur réseau porte un certain nombre de tubercules disposés çà et là. Les pédicelles renferment des bâtonnets aplatis, munis de quelques ramifications latérales qui peuvent se souder entre elles et limiter ainsi des cavités dont le pourtour est parfois tuberculé (pl. ii, fig. 15 et fig. 12a et b). Les tentacules renferment des corpuscules en forme de bâtonnets aplatis, présentant une série linéaire de perforations dont le pourtour est garni de nombreux tubercules (pl. ii, fig. 11).

L'anneau calcaire est très grêle et mesure 1 mm. de hauteur; il est constitué par dix pièces en forme d'accent circonflexe, les pièces radiales étant plus développées que les interradianes (pl. ii, fig. 14). La vésicule de Poli, unique, est grisâtre et sa longueur atteint 5 mm. Le canal madréporique est très court; la plaque est petite dans l'un des exemplaires, tandis qu'elle est de grande taille chez un autre.

Tous les viscères sont grisâtres. Les organes génitaux sont constitués par une houppe de nombreux tubes simples.

Rapports et différences.—Par la forme des tentacules, la *Cucumaria digitata* rappelle la *C. inflexa* que nous avons fait connaître dans un mémoire antérieur (*Holothuries recueillies par l' "Investigator" dans l'Océan Indien*: II, Les Holothuries littorales, Calcutta, 1908, p. 35) et elle nous offre ainsi un nouvel exemple de *Cucumaria* ne présentant pas les tentacules arborescents caractéristiques des *Dendrochirotes*. Les tentacules sont, en effet, simplement coniques et ils ont la forme que l'on observe chez le *Psolus digitatus* Ludwig, et les *Ypsilothuria*, ainsi que chez certaines *Molpadiidés* (*Eupyrus* et *Aphelodactyla*).

Les différences de forme que présentent la *C. digitata* sont une nouvelle preuve que le genre *Siphothuria*, proposé en 1886 par Edmond Perrier et basé surtout sur la courbure du corps, ne peut-être maintenu; d'ailleurs Rémy Perrier a déjà discuté longuement la validité de ce genre et nous renvoyons le lecteur à son mémoire (*Expéditions Scientifiques du "Travailleur" et du "Talisman," Holothuries*, p. 497).

C'est de la *C. inflexa* Koehler et Vaney, que la *C. digitata* se rapproche le plus par la forme des tentacules et par la structure des plaques calcaires des téguments, mais les bâtonnets calcaires des pédicelles et des tentacules ont une forme bien différente.

Cucumaria imbellis, sp. nov.

(Pl. iii, fig. 2—5.)

Station 355. Lat. N. 21° 49' 50'. Long. E. 59° 48'. Profondeur 492 brasses. Un échantillon.

Le corps est légèrement incurvé du côté dorsal et les extrémités sont arrondies (pl. iii, fig. 4); la longueur est de 12 mm. et le diamètre de 5 mm. Dans le trivium, les pédicelles sont localisés sur les radius, où ils sont disposés en une double rangée longitudinale qui s'arrête à une faible distance de l'anus. Sur le bivium,

les pédicelles se trouvent disséminés à la fois sur les interradius et sur les radius, mais ils paraissent plus nombreux sur ces derniers. L'ouverture anale est entourée par cinq dents calcaires.

Les téguments sont d'un blanc grisâtre et ils renferment de nombreuses plaques calcaires imbriquées. Ces dernières ont des contours arrondis et elles présentent généralement quatre grandes ouvertures (pl. iii, fig. 5); certaines d'entre elles offrent un plus grand nombre de perforations. Les pédicelles renferment des plaques calcaires allongées suivant un de leur diamètre; leur portion moyenne, élargie, est losangique et elle présente quatre grandes ouvertures (pl. iii, fig. 3a, b et c). L'anneau calcaire a un millimètre et demi de hauteur; il se compose de dix pièces terminées en pointe en avant; les pointes des pièces interradiales sont plus faibles que celles des radiales. En arrière, chaque pièce radiale se continue par deux prolongements dont la longueur ne dépasse pas 1 mm. (pl. iii, fig. 2).

Rapports et différences.—La *Cucumaria imbellis* se distingue facilement des autres espèces par les plaques perforées du tégument qui ne supportent pas de tourelles, par la structure des bâtonnets des pédicelles, par la forme de l'anneau calcaire et par la présence de cinq dents anales. Les bâtonnets des pédicelles ressemblent beaucoup à ceux de notre *C. ariana*, mais les téguments de cette espèce renferment des tourelles massives.

La disposition des pédicelles sur les radius du trivium de la *C. imbellis* rappelle beaucoup ce qu'on observe chez les *Colochirus*, mais les prolongements postérieurs de l'anneau calcaire éloignent notre espèce de ce genre.

Cucumaria mosaïca, sp. nov.

(Pl. ii, fig. 1—5.)

Station 292. Lat. N. 26° 20'. Long. E. 53° 54'. Profondeur 53 brasses. Un échantillon.

Le corps, incurvé en forme de V, est aplati latéralement; les extrémités s'atténuent progressivement et elles sont relevées du côté dorsal (pl. ii, fig. 4). La longueur de l'exemplaire est de 12 mm., sa plus grande hauteur, située dans la région médiane, est de 4 mm. 5 et son épaisseur atteint 4 mm. environ. Les radius sont légèrement saillants et l'on remarque des pédicelles sur toute leur longueur où ces appendices sont localisés. Les radius du trivium présentent un plus grand nombre de pédicelles que ceux du bivium.

Les téguments sont rigides; ils renferment un grand nombre de plaques calcaires arrondies et à surface externe convexe qui forment extérieurement une espèce de mosaïque; les pédicelles émergent entre les granulations. Les plaques sont plus ou moins imbriquées; elles sont de grosseur variable, des plaques de petites dimensions se trouvant intercalées entre des plaques deux et même trois fois plus grandes. Chacune d'elle résulte

de la superposition de deux ou trois couches formées de trabécules anastomosées dont la plus superficielle est la moins développée (pl. ii, fig. 1).

Les pédicelles ventraux renferment des corpuscules en forme de biscuit, le plus souvent incurvés, et offrant généralement trois perforations : une centrale et deux terminales (pl. ii, fig. 3*a* et *b*). Au centre de certains de ces corpuscules s'élève un arceau limitant deux ouvertures superposées (pl. ii, fig. 2*a*, *b*, et *c*).

L'anneau calcaire possède une région antérieure rigide ayant un demi-millimètre de hauteur et présentant dix pointes en avant ; en arrière, il offre dix prolongements radiaires de 2 mm. 5 de longueur et composés chacun d'une seule série d'articles (pl. ii, fig. 5).

Nous ne pouvons fournir aucune indication sur l'organisation interne, tous les viscères étant absents.

Rapports et différences.—La *Cucumaria mosaïca* rappelle notre *C. rapax*, mais elle s'en distingue nettement par l'absence de tubercules sur les radius.

Cucumaria perdita, sp. nov.

(Pl. iii, fig. 6—9.)

Station 356. Lat. N. 17° 59'. Long. E. 57° 22' 30''. Profondeur 156—200 brasses. Deux échantillons.

Les deux exemplaires sont blanchâtres et leurs dimensions sont presque identiques. Le corps, légèrement incurvé, a la forme d'une cornemuse et il rappelle notre *Cucumaria inflexa* ; il a 22 mm. de longueur, 10 mm. de largeur et 13 mm. de hauteur dans sa partie moyenne ; les deux extrémités sont un peu relevées du côté dorsal.

Les pédicelles sont disposés en deux rangées qui sont assez serrées sur les radius ; ils sont en plus grand nombre sur les radius ventraux que sur les radius dorsaux. Dans les espaces interradiaux, se montrent quelques pédicelles disséminés sur le trivium ; ces pédicelles, tout en restant assez espacés les uns des autres, sont beaucoup plus nombreux sur le bivium. Vers les extrémités antérieure et postérieure, les rangées radiales sont très marquées et saillantes et elles donnent un contour pentagonal à ces régions terminales.

La paroi du corps renferme des corpuscules turriculaires (pl. iii, fig. 9*a*, *b*, *c*, *d*, *e* et *f*). Les tourelles sont peu élevées ; elles se terminent par une couronne hérissée de quelques tubérosités périphériques et qui surmonte un arceau formé par deux courts piliers ; ceux-ci reposent sur une base quelquefois incurvée, constituée par une plaque arrondie ou ovale percée d'un grand nombre de perforations dont le diamètre est assez variable.

Les pédicelles dorsaux renferment des corpuscules turriculaires à base allongée, présentant une portion médiane élargie à quatre perforations et supportant, en son centre, l'arceau de la tourelle ; cette base se continue suivant son grand axe en deux prolonge-

ments plus étroits, qui s'élargissent à leur extrémité et offrent alors une ou deux perforations (pl. iii, fig 7a, b, c et d).

Les pédicelles ventraux possèdent des corpuscules calcaires en forme de plaques allongées, quelquefois incurvées, assez semblables aux bases des corpuscules turriculaires des pédicelles dorsaux, mais ces plaques ne présentent jamais d'arceau central sur leur partie médiane élargie; celle-ci offre quatre ouvertures de dimensions différentes: deux grandes et deux petites (pl. iii, fig. 8a, b, c, d et e).

Les tentacules sont au nombre de dix, dont huit sont opalescents et offrent un contour très déchiqueté; les deux autres, ventraux, sont de plus petite taille.

L'anneau calcaire a 6 mm. de longueur; il présente une partie antérieure qui se prolonge en avant par dix pointes: les pointes radiales sont plus développées que les interradianes. Cet anneau est constitué par un grand nombre de plaques polygonales soudées les unes aux autres; il atteint 1 mm. 5 de hauteur et il se continue en arrière par dix prolongements radiaires constitués chacun par plusieurs plaques soudées entre elles (pl. iii, fig. 6). Les muscles rétracteurs sont courts. La vésicule de Poli, unique, a une longueur de 6 mm. Le canal madréporique, unique, a 1 mm. de longueur et il est légèrement infléchi en avant. Les organes génitaux sont constitués par un faisceau de nombreux tubes simples, de couleur blanc jaunâtre et localisés surtout dans la moitié antérieure du corps. L'autre moitié renferme les organes arborescents dont la couleur est également blanc jaunâtre; ceux-ci présentent des ramifications latérales nombreuses et courtes.

Rapports et différences.—La *Cucumaria perdita* rappelle, par sa forme extérieure, notre *C. inflexa*, mais elle s'en distingue par ses pédicelles disséminés sur les interradianes; de plus les corpuscules calcaires sont bien différents.

Par la structure des corpuscules calcaires, cette nouvelle espèce se rapproche de nos *Cucumaria rapax* et *ardens*, mais la forme de l'anneau calcaire s'écarte de celui que nous avons décrit dans ces deux espèces. Il rappelle celui de notre *C. pigra*, mais les corpuscules médusiformes de cette espèce ne se retrouvent pas dans la *C. perdita*.

ESPÈCES DÉJÀ CONNUES.

SYNALLACTIDÉS.

1. *Mesothuria multipes* Ludwig.

Station 301. Lat. N. 24° 37' 30". Long. E. 62° 2' 30". Profondeur 1,000 brasses. Deux échantillons.

2. *Pelopatides verrucosus* Koehler et Vaney.

Station 327. Lat. N. 17° 7' 30". Long. E. 94° 5' 30". Profondeur 419 brasses. Deux échantillons.

HOLOTHURIIDÉS.

3. *Holothuria atra* Jäger.

Iles Nicobar Deux échantillons.

4. *Holothuria ocellata* Jäger.

Provenance inconnue Deux échantillons.

5. *Holothuria tenuissima* Semper.

Provenance inconnue Un échantillon.

CUCUMARIIDÉS.

6. *Colochirus violaceus* Théel.

24 février 1909. Côtes d'Orissa. Trawler "Golden Crown." Profondeur 20 brasses. Quatre échantillons.

MOLPADIIDÉS.

7. *Molpadia (Trochostoma) andamanensis* (Walsh).

Station 299.	Lat. N. 23° 43'.	Long. E. 58° 51' 30".	Profondeur 1,299 brasses.	Un échantillon.
„ 300.	„ 24° 16'.	„ 60° 26'.	Profondeur 1,375 brasses.	Un échantillon.
„ 313.	„ 15° 21'.	„ 92° 48' 45".	Profondeur 1,500 brasses.	Un échantillon.
„ 320.	„ 7° 23'.	„ 75° 44'.	Profondeur 1,053 brasses.	Un échantillon.
„ 332.	„ 10° 21'.	„ 92° 46' 1/4".	Profondeur 279 brasses.	Un échantillon.

8. *Molpadia (Trochostoma) granulata* (Ludwig).

Station 313. Lat. N. 15° 21'. Long. E. 92° 48' 45". Profondeur 1,500 brasses. Deux échantillons.

9. *Molpadia (Ankyroderma) musculus* (Risso).

Station 290.	Lat. N. 24° 53'.	Long. E. 57° 43'.	Profondeur 733—833 brasses.	Un échantillon.
„ 297	„ 25° 11' 30"	„ 57° 15'.	Profondeur 689—700 brasses.	Quatre échantillons.
„ 299	„ 23° 41' 00"	„ 58° 51' 30".	Profondeur 1,299 brasses.	Un échantillon.
„ 304	„ 20° 19' 45"	„ 68° 55' 30".	Profondeur 1,034—1,051 brasses.	Deux échantillons.
„ 310	„ 13° 29' 30"	„ 95° 29'.	Profondeur 960 brasses.	Un échantillon.
„ 315	„ 10° 06'.	„ 92° 29'.	Profondeur 705 brasses.	Six échantillons.

Station 316	Lat. N. $5^{\circ} 43' 30''$	Long. E. $80^{\circ} 05' 30''$	Profondeur 1,500 brasses. Deux échantillons.
„ 318	„ $7^{\circ} 28'$	„ $79^{\circ} 19' 30''$	Profondeur 1,085 brasses. Quatre échantillons.
„ 319	„ $12^{\circ} 02'$	„ $73^{\circ} 46'$	Profondeur 1,154 brasses. Deux échantillons.
„ 321	„ $5^{\circ} 4' 8\frac{1}{2}''$	„ $80^{\circ} 22'$	Profondeur 660 brasses. Un échantillon.
„ 322	„ $11^{\circ} 26' 30''$	„ $92^{\circ} 53' 45''$	Profondeur 378 brasses. Quatre échantillons.
„ 325	„ $18^{\circ} 18'$	„ $93^{\circ} 25'$	Profondeur 843 brasses. Trois échantillons.
„ 327	„ $17^{\circ} 7' 30''$	„ $94^{\circ} 5' 30''$	Profondeur 419 brasses. Un échantillon.
„ 338	„ $19^{\circ} 51'$	„ $69^{\circ} 09'$	Profondeur 839 brasses. Deux échantillons.
„ 358	„ $15^{\circ} 55' 30''$	„ $52^{\circ} 38' 30''$	Profondeur 585 brasses. Deux échantillons.
„ 359	„ $14^{\circ} 41' 30''$	„ $50^{\circ} 33' 15''$	Profondeur 674 brasses. Un échantillon.
„ 360	„ $13^{\circ} 36'$	„ $47^{\circ} 32'$	Profondeur 385 brasses. Trois échantillons.
„ 363	„ $14^{\circ} 28' 45''$	„ $50^{\circ} 00' 15''$	Profondeur 810 brasses. Trois échantillons.

10. *Molpadia (Ankyroderma) musculus* (Risso) var. *acutum*,
Koehler et Vaney.

Station 331. Lat. N. $11^{\circ} 46' 30''$. Long. E. $93^{\circ} 16'$. Profondeur
569 brasses. Deux échantillons.

11. *Aphelodactyla (Haplodactyla) molpadioides* (Semper).

21 Septembre	'08.	Balasore Bay.	B. F. Trawler	“Golden Crown.”
				Un échantillon.
Aout	'08.	Off Orissa Coast.	„ „	“Golden Crown.”
				Deux échantillons.
Octobre	'08.	Off Puri.	„ „	“Golden Crown.”
				Deux échantillons.

Les échantillons ont tous été conservés dans le formol et la plupart sont dépourvus de corpuscules calcaires.

SYNAPTIDÉS.

12. *Protankyra challenger*¹ Théel.

Station 310. Lat. N. $13^{\circ} 29' 30''$. Long. E. $95^{\circ} 29'$. Profondeur
960 brasses. Un échantillon.

¹ H. Lyman Clark a montré que la *Protankyra challenger* était une forme très polymorphe et il lui réunit un certain nombre de *Protankyra* abyssales

13. *Polycheira (Chiridota) rufescens* (Brandt).

Sans provenance Un échantillon.

antérieurement décrites comme espèces distinctes; parmi elles se trouve notre *Protankyra timida*.

Nous nous rangeons volontiers à la manière de voir de Lyman Clark en ce qui concerne l'extension à donner à la *P. challengerii*; mais nous sommes d'avis de conserver, à titre de variété, notre *P. timida*, car elle offre des caractères assez différents du type de Théel.

Nous rattachons donc à la *Protankyra challengerii* une Synapte venant de la Station 310 par 960 brasses de profondeur. Ses téguments renferment des plaques anchorales dont la structure est assez analogue à celle représentée par Théel, mais la poignée des ancras possède des digitations très développées et les bâtonnets accessoires sont allongés, légèrement arqués et ils rappellent par leur forme ceux du *Protankyra sluiteri* Fisher.





EXPLICATION DE LA PLANCHE I.

FIG. 1 à 10.—*Bathyplotes cinctus*, sp. nov.

Fig. 1.—Individu vu par la face ventrale, très légèrement réduit.

„ 2, *a* et *b*.—Corpuscule turriforme de la région basilaire des papilles dorsales. Gr.=175.

„ 3, *a*.—Tourelle des téguments de la face dorsale. Gr.=330.

„ 3, *b*.—Base d'un corpuscule turriforme des téguments de la face dorsale. Gr.=330.

„ 4.—Portion de l'anneau calcaire. Gr.=3·5.

„ 5.—Base d'un corpuscule turriforme des téguments de la face ventrale. Gr.=330.

6, *a* et *b*.—Tourelles de la base des papilles dorsales. Gr.=175.

„ 7.—Corpuscule en C des téguments de la face dorsale. Gr.=330.

„ 8.—Tourelle des papilles dorsales. Gr.=175.

„ 9.—Bâtonnet des papilles dorsales. Gr.=175.

„ 10.—Bâtonnet des pédicelles ventraux. Gr.=330.

FIG. 11 à 17.—*Bathyplotes roseus*, sp. nov.

Fig. 11.—Individu vu par la face ventrale, très légèrement réduit.

„ 12, *a*, *b* et *c*.—Corpuscules des pédicelles ventraux. Gr.=175.

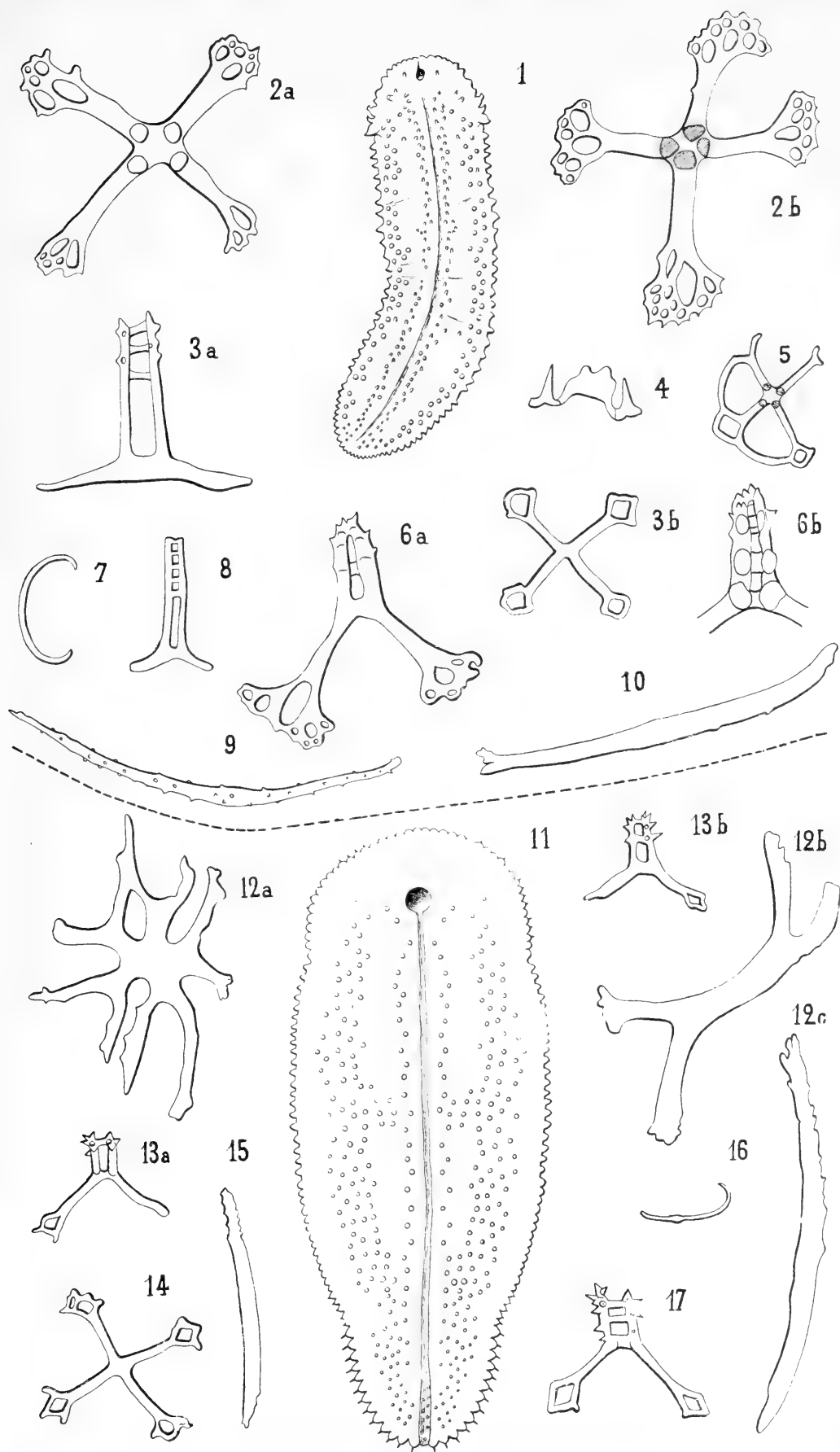
„ 13, *a* et *b*.—Tourelles des papilles dorsales. Gr.=175.

„ 14.—Base d'un corpuscule turriforme du tégument de la face dorsale. Gr.=175.

„ 15.—Bâtonnet des papilles dorsales. Gr.=175.

„ 16.—Corpuscule en C du tégument de la face dorsale. Gr.=175.

„ 17.—Corpuscule turriforme du tégument de la face ventrale. Gr.=330.





EXPLICATION DE LA PLANCHE II.

FIG. 1 à 5.—*Cucumaria mosaïca*, sp. nov.

Fig. 1.—Plaque à trois réseaux superposés de la paroi du corps. Gr.=330.

,, 2, *a*, *b* et *c*.—Corpuscules des pédicelles ventraux, vus de côté. Gr.=330.

,, 3, *a* et *b*.—Corpuscules des pédicelles ventraux, vus de face. Gr.=330.

,, 4.—Individu entier vu de côté. Gr.=4.

,, 5.—Portion de l'anneau calcaire. Gr.=11.

FIG. 6 à 10.—*Synallactes anceps*, sp. nov.

Fig. 6.—Individu entier vu par la face ventrale, très légèrement réduit.

,, 7.—Individu vu par la face dorsale, très légèrement réduit.

,, 8.—Base d'un corpuscule turriciforme. Gr.=330.

,, 9, *a* et *b*.—Tourelles réduites à une seule tige des corpuscules turriciformes. Gr.=175 pour *a* et 330 pour *b*.

,, 10.—Bâtonnet des pédicelles ventraux. Gr.=175.

FIG. 11 à 17.—*Cucumaria digitata*, sp. nov.

Fig. 11.—Bâtonnet des tentacules. Gr.=55.

,, 12, *a* et *b*.—Bâtonnets des pédicelles latéraux. Gr.=330.

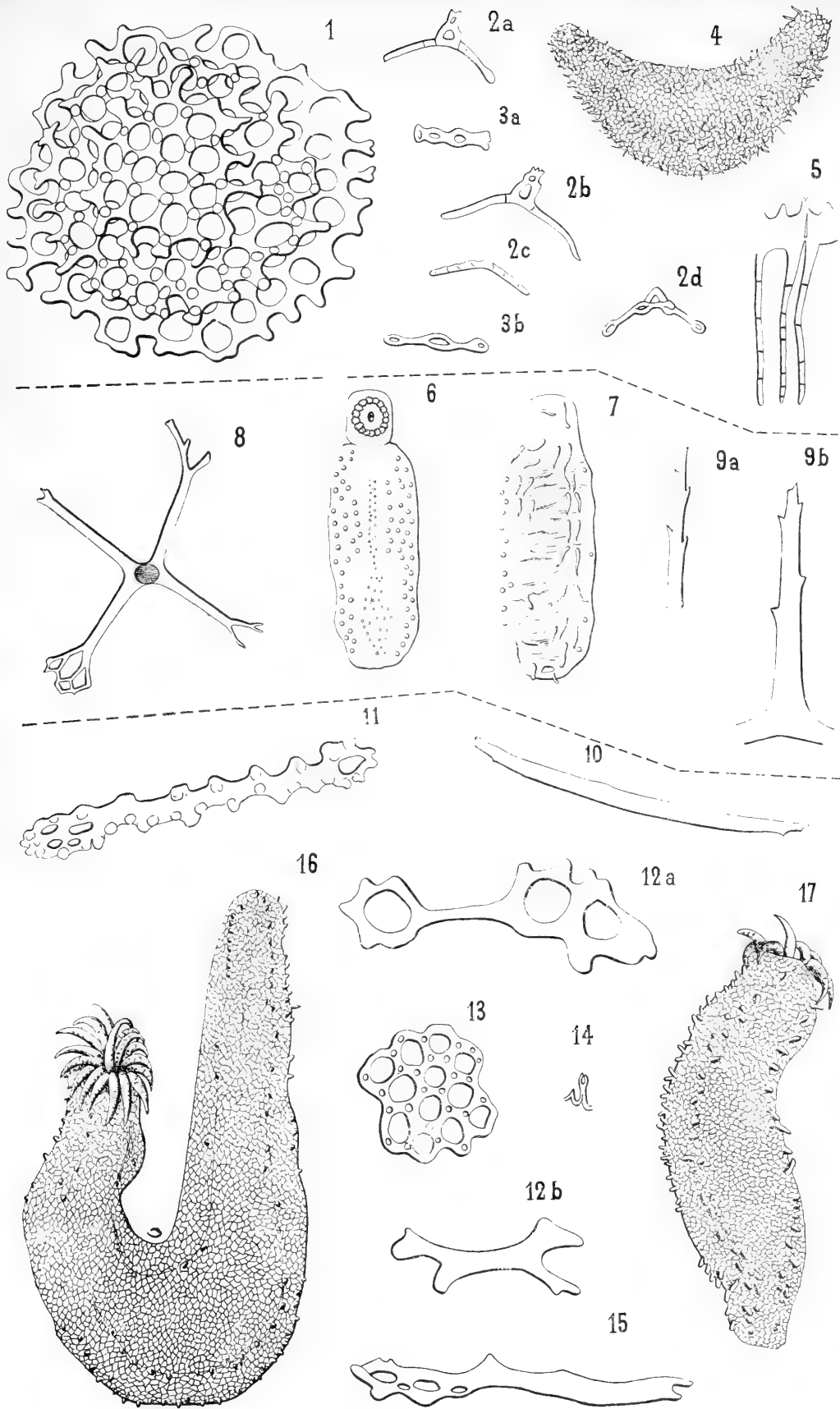
,, 13.—Plaque de la paroi du corps. Gr.=55.

,, 14.—Portion de l'anneau calcaire. Gr.=5.

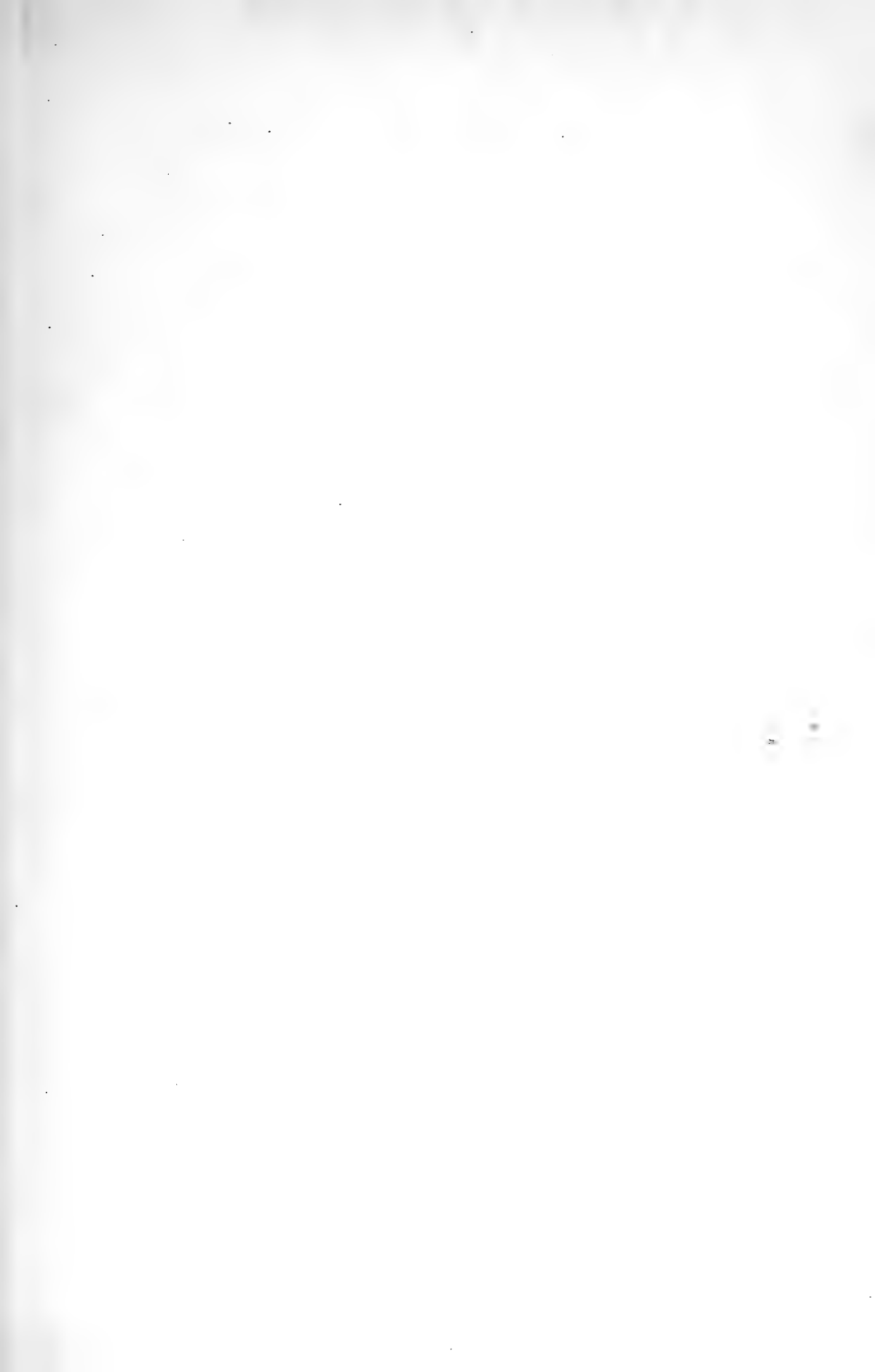
,, 15.—Bâtonnet des pédicelles ventraux. Gr.=55.

,, 16.—Individu fortement incurvé. Gr.=4 environ.

,, 17.—Individu faiblement incurvé. Gr.=4 environ.







EXPLICATION DE LA PLANCHE III.

FIG. 1.—*Enypniastes* (?) *decipiens*, sp. nov., vu par la face ventrale; légèrement réduit.

FIG. 2 à 5.—*Cucumaria imbellis*, sp. nov.

Fig. 2.—Portion de l'anneau calcaire. Gr.=24.

„ 3, *a*, *b* et *c*.—Corpuscules des pédicelles. Gr.=330.

„ 4.—Exemplaire vu de côté. Gr.=4.

„ 5.—Plaque de la paroi du corps. Gr.=330.

FIG. 6 à 9.—*Cucumaria perdita*, sp. nov.

Fig. 6.—Portion de l'anneau calcaire. Gr.=5.

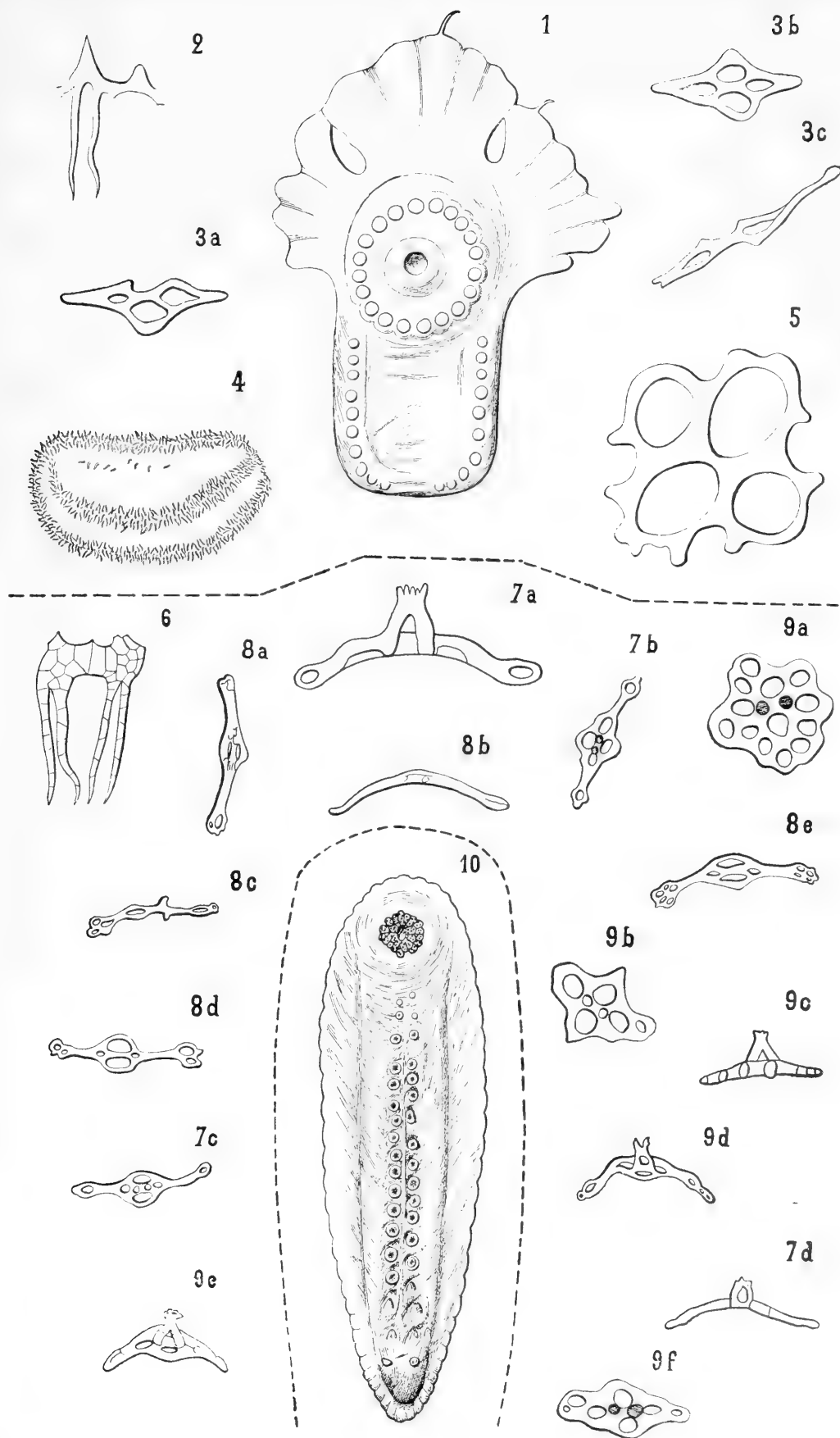
„ 7, *a*.—Corpuscule des pédicelles dorsaux, vu de côté. Gr.=250.

„ 7, *b*, *c* et *d*.—Corpuscules des pédicelles dorsaux. Gr.=175.

„ 8, *a*, *b*, *c*, *d* et *e*.—Corpuscules des pédicelles ventraux. Gr.=175.

„ 9, *a*, *b*, *c*, *d*, *e* et *f*.—Corpuscules turriculaires des téguments de la face dorsale. Gr.=175.

FIG. 10.—*Peloplatides dissidens*, sp. nov., vu par la face ventrale, légèrement réduit.



IX. FURTHER OBSERVATIONS ON THE RACES OF INDIAN RATS.

By R. E. LLOYD, *M.B., D.Sc., Professor of Biology, Medical College, Calcutta.*

In a recent number of the *Records of the Indian Museum* (vol. iii, pt. 1, 1909) I brought forward some evidence in favour of the opinion that discontinuous variation plays an all-important part in the production of new races. The observations on which this evidence was based were made upon some thousands of common house rats, which had been captured in many parts of India. The subject may be summarized as follows:—

It was found that the common house rats of India are, in a broad sense, of one species. It is not possible to find any sure criterion by which a house rat caught in the Punjab can be distinguished from one caught in Bombay or Bengal: but taken individually, the rats of any particular town are sometimes different from one another, especially in the kind and distribution of the pigment which determines their coat colour. Some of the differences, to which I refer, are of such magnitude that those specimens which exhibit them, can be distinguished from one another even at a distance of thirty yards in a good light. The common house rats of India are of the type long known by the name of *Mus rattus*; they are usually of a dull brown colour which is somewhat lighter on the ventral surface.

In many Indian towns, thousands of house rats have been captured for sanitary purposes, and there is no doubt that the whole-coloured brown type is predominant. But sometimes other varieties are found along with the common kind. Of these other varieties, the commonest by far is one in which the fur of the whole ventral surface, of the belly, breast, throat and chin is pure white, the whiteness being sharply defined from the brown colour of the sides. Another less common variety is wholly black. In another variety the tail is partially white, in others there is a white patch on the forehead, or a white line on the breast.

The evidence for discontinuous evolution lies in the manner in which these varieties are distributed among the multitude of brown whole-coloured rats. In some towns, rats were caught in such large numbers that it was possible to ascertain the constitution of the rat population. It was found that the varieties occurred among the others in small groups, which were in some cases large enough to occupy two adjacent houses to the exclusion of other rats. The constitution and circumstances of some of these "family groups" was ascertained, but it was not possible to discover the method of their origin. It is an assumption to suppose

that these varieties appeared in the first case as the offspring of normal self-coloured parents ; even if, as I believe, we are justified in making the assumption, there is no evidence to show whether the normal parents produced successive and entire litters of abnormal offspring, or an occasional "black sheep" from time to time. Judging from events which have been recorded from time to time it seems that the latter is the more likely supposition.

The following statement will illustrate the way in which the question often presented itself : While in Madras City I had, during three days, the opportunity of seeing more than a thousand common house rats, and as a result of a somewhat cursory examination, I concluded that all were of the common brown whole-coloured type of *Mus rattus* ; but from among them I picked out two which had a pure white line in the middle of the breast. The conclusion that one naturally jumps to is that these two, or their parents, or a near ancestor which showed the same peculiarity, must have been the offspring of normal parents. Although this conclusion is not supported by any actual evidence, it appears to be sound because we cannot find any other explanation.

But even if we regard their primary origin as uncertain, there is no shadow of doubt but that these abnormal rats sometimes occur in groups which may occupy two or more adjacent houses from which the normal rats have been displaced. It is this particular point which I wish to emphasize. The question was first placed beyond doubt in the case of the black variety of *Gunomys bengalensis* which was found in Rangoon. Twelve rats of this kind were caught in two adjacent houses, and no other rats of any kind entered the traps set in those houses during the time of their capture. It is certain that the black variety of *G. bengalensis* is not a common rat in Rangoon, and it has never been found except in Rangoon. During the year of my visit there, rats were being caught at the rate of four thousand a day. Before these twelve peculiar rats were captured, others like them had been brought very occasionally to the collecting stations, but it was not until nearly six months after the capture of the twelve, that two others were obtained. There is apparently no reason why these black rats should not have increased in numbers until they occupied ten or a hundred houses. Their success or failure would of course be decided in the stress of that competition which occurs among all living things.

Finally, there is a probability that established races such as are recognised by taxonomists as "good species" have arisen in the way indicated : because the characters upon which these species have been defined, are in some cases exactly the same as those which are found in the abnormal individuals or sports which occur along with the normal rats of India. For example, the character of albiventrism is a peculiarity of many well-known species of the *Mus rattus* group. A more striking example is presented by those species of rats in which the terminal third of the tail is white. The species *Mus blanfordi*, which is found in the hills of Madras, possesses this character, as do other species which have

been recorded from the Philippines. Rats possessing this same character have lately been met with in three separate parts of India. The circumstances of their capture show that they were not wandering members of an established race, but sports which have suddenly appeared among the common whole-coloured rats.

I have repeated the chief arguments of my last paper in a more decided manner: as it was said, perhaps with some truth, that they were indicated rather than expressed therein. Moreover, other observations have since been made which afford confirmation. These will now be dealt with.

Observations made at Poona.

These are of special importance because of their accuracy. Most of the rat-killing measures in India have been undertaken in order to prevent plague; to destroy the animals in large numbers has been the chief endeavour. But at Poona the destruction was carried out systematically by the Plague Commission, as an experiment. In the interval between the 26th May, 1908, and 22nd May of the following year, 45,487 rats were caught in Poona. They were not purchased indiscriminately from the town folk, but were captured in the following manner: Every night a large number of traps were set in certain houses of the town; each trap was labelled with the address of the house in which it was placed; next morning the traps were examined and those containing rats, in all to the number of 100 or more, were taken to the laboratory. Each rat then became the subject of various observations, which were recorded in a serial register. The points observed were those which might help the Commission in its task, such as the number of fleas on each rat, the pathological condition of the rat, the state of pregnancy, etc. For the biologist, it is most fortunate that any peculiarity of the outward appearance of the rats, as well as the place of residence of each one of them, were included among the records.

Case 1.—The house rats of Poona as a class have no special peculiarities; they are on the average slightly smaller than the rats of Bombay and some other cities; they are of the whole-coloured brown type, but are much less variable than those of Bombay City, where the black and the white-bellied varieties are comparatively common: indeed, they were almost of daily occurrence among the two or three hundred common rats which were being caught at that place. At Poona, however, among all the forty-five thousand rats which were caught during the year, there was not a single black one and there were only nineteen of the white-bellied variety. Of these nineteen I was able to obtain three, which were caught while I was at Poona. This was not due to chance, but to the fact that traps were specially set on my behalf in those houses from which white-bellied rats had previously been captured.

The white-bellied rats of Poona are exactly like the common ones, except for the one peculiar character which renders them

conspicuous ; so conspicuous are they among the others that it is the custom of the Plague Commissioners to refer to them for convenience as *Mus alexandrinus* as a nominal distinction from the common *Mus rattus*. This is in accordance with the modern use of the word "species," for two animals which appear different from one another at a glance are usually considered to be of different species. The name *M. alexandrinus*, as used in this particular case, might, however, be regarded by a systematist as calling for correction ; it is, therefore, preferable to use the term white-bellied variety. The map, plate x, shows exactly how far this variety is established in the city of Poona ; it must be remembered that forty-five thousand whole-coloured rats have been taken from the city at large and that there is scarcely a house which has not contributed to the total. The nineteen white-bellied rats were caught in nine houses ; four of these were contiguous and two others are separated from them by the width of a street. Six of the houses therefore form a distinct focus of habitation for rats of this special variety. The other three houses form another centre, perhaps more than one, which is situated about 250 yards further south.

The following table is an extract from the register and shows the order in which the rats were caught. The reality of the foci became gradually recognised as the trapping was continued in every part of the city.

House.	Reference to map.	W. B. rats.
Raiwar 380	1	3
„ 338	2	2
„ 963	3	2
„ 1146	4	1
„ 1191	5	2
„ 553	6	2
„ 381	7	2
„ 382	8	3
„ 379	9	2
		—
		19

The serial numbers 1 to 9 refer to the order of capture of the rats and indicate the particular houses on the map. The focus which is represented by the six houses, 379—382, 553, 963, Raiwar, contributed fourteen rats, but this fact does not give us a true idea of the size of the colony ;—if two or three rats are caught in a house their companions become wary and avoid the traps. In all probability this particular colony numbered a hundred or more individuals.

We therefore arrive at the following conclusions : Poona is a large town with a rat population of a million or more. The nature of this population has been fairly sampled by subtracting 45,000 of them from all parts of the city ; the rats are for the most part of the whole-coloured brown type, but established in the heart of the city is a colony of white-bellied rats which contains in all

probability a hundred or more individuals ; this is inferred because six adjacent houses are known to contain them and, so far as could be ascertained, no others.

The question now arises as to how this state of affairs came about. The progenitors of the colony were either born in the city from normal parents or they are migrants of another race which arrived from without. In my opinion it is unnecessary to discuss the probability or possibility of the founders of the colony creeping unobserved into the heart of the town or arriving there in corn sacks, since we do not know whencesoever they can have come. There is no extensive area in India which is inhabited by a pure race of white-bellied rats. They are to be found in isolated groups side by side with the commoner whole-coloured rats in several parts of the Peninsula, especially in the south-eastern part of Madras, but there is no particular centre from which they can have migrated.

Case 2.—It was mentioned previously, that rats are occasionally found which are marked with a pure white line in the middle of the breast. The same kind of sport has been noticed in Bombay, Madras, Nowgong and Calcutta. At Poona I obtained four half-grown rats which were caught together in a trap. All of them have this breast mark, they are exactly in the same stage of adolescence and are obviously of the same litter ; an adult rat showing the same character was caught in another trap close by. These rats are shown in the photograph, plate ix. This case helps to prove that, however such a character originates, it is passed on to all the members of a litter in the succeeding generations, and by analogy it helps us to understand how the group of white-bellied rats which were established in the six contiguous houses came into being. There is no apparent relation between the white breast mark, as a character unit, and albiventrism as such. Intermediate forms, showing a widening and lengthening of the breast line and bridging over the gap between the two extremes, were not found in Poona. In some parts of India, for example in Simla, rats have been found which are marked with variable patches of white on the abdomen (*ibid.*, pages 37, 38). The white breast line appears to be a definite character, not only among Indian rats, but among those of other countries. The species "*Mus hibernicus*" was established to commemorate a group of black rats which was found in Ireland. It has been shown that this species is a melanotic variety of *Mus decumanus* plus a white breast line. The published illustration of the skull of the Irish rat might indeed have been drawn from any *Mus decumanus* such as is common in Bombay and Calcutta. A white breast line occurs in animals other than rodents, for example in dogs.

Naini Tal.

A second visit to this place has enabled me to confirm the previous conclusions (*ibid.*, pages 38, 89), but in one respect to correct them. Since plague preventative measures were not in force at

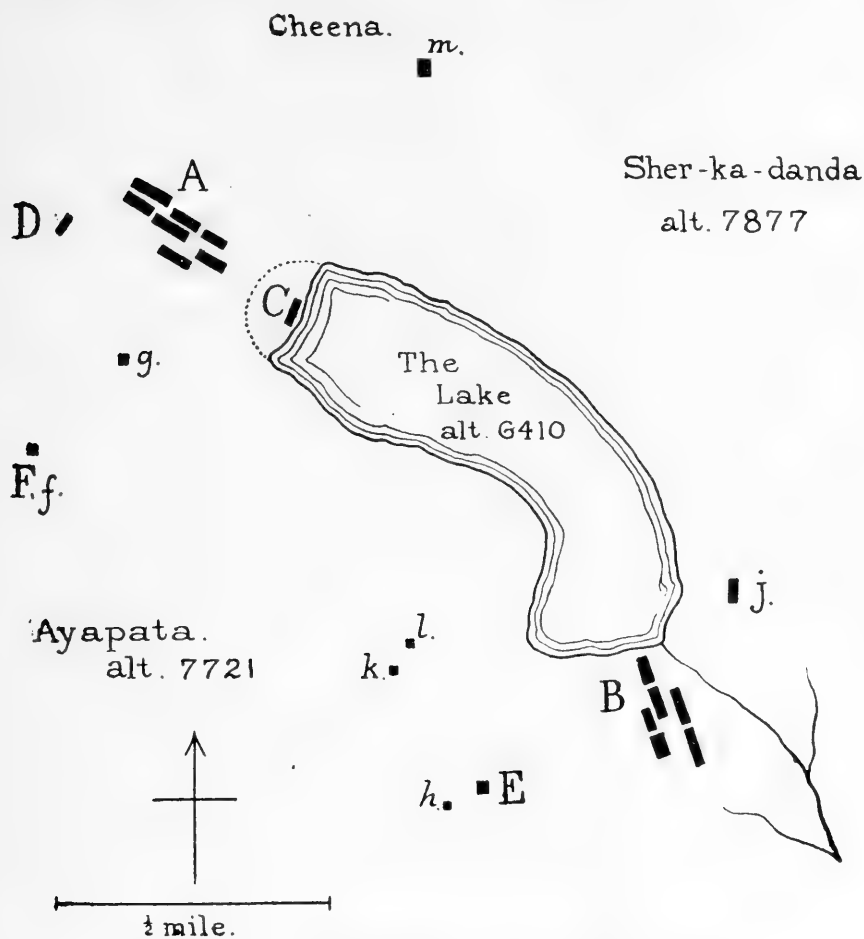
Naini Tal, it was difficult to obtain the rats in large numbers, this state of things was a cause of error in one direction. The previous conclusions may be summarized as follows :—

- (1) The rats of Naini Tal differ from those of the plains in the following respects :—
 - (a) they have on the average shorter tails ;
 - (b) their fur is longer and more plentiful and is of a greyer tint ;
 - (c) they are white-bellied, but a few of them are not quite pure in this respect ; in most of them every hair of the ventral surface is white in its whole length, as is usually the case in white-bellied rats ; but in a few of them the ventral hairs are light grey as regards the proximal half.
- (2) A special class of rats was discovered in ten specimens which were caught in some adjacent buildings on Ayapata Hill. These are exactly the same as the others except as regards the colour of the tail. The tail of a rat is usually pigmented in its whole circumference, but in these the lower surface is pure white and devoid of all pigment, the upper surface is deeply pigmented in a variable area, in only one of them did it extend to the tip, in the others it extended to the middle of the length of the tail, in others not quite so far as this point, while in others it extended beyond it.

A second and more thorough investigation of the Naini Tal rats amply confirmed these first impressions, but showed that the range of the Ayapata race was much more extensive than was at first supposed ; but there is no doubt of the distinction between the two classes, nor is there any doubt that the distinction lies only in the colour of the tail. The enquiry into the relative distribution of the common or black-tailed class and the Ayapata class with the bicolored tails, which was carried out in May of last year, will now be dealt with. The result may be summarized as follows :—

- (1) Any one house contains rats of one or other kind, not of both ; there is one exception to this rule in the case of the house, Dalhousie Villa.
- (2) The largest masses of buildings, such as the bazaars and shops which are situated at either end of the lake, contain black-tailed rats.
- (3) Isolated buildings distant from and above the level of the lake generally contain white-tailed rats.
- (4) But two buildings which are separated from one another by a few yards only may contain rats of the different kinds.

The distribution of the two kinds of rats in Naini Tal, so far as it has been ascertained, is shown in the following table which shows the numbers captured.



Map of Naini Tal showing places at which rats were caught.

			Designation on map.	Black-tailed rats.	White-tailed. rats.
North Bazaar	..	..	A.	Many	0
South Bazaar	..	..	B.	Many	0
Assembly rooms	..	..	C.	3	0
Hotel Metropole	..	..	D.	3	0
Government House	..	..	E.	1	0
Dalhousie Villa	..	..	F.f.	2	4
Priory Lodge	..	..	g.	0	4
Sherwood	..	..	h.	0	5
Ramsay Hospital	..	..	j.	0	1
Ayapata House	..	..	k.	0	7
Derham House	..	..	l.	0	3
Old Govt. House	..	..	m.	0	3

We can only speculate as to how this state of things came about. At the present day Naini Tal is a large cantonment lying among the Himalayas at an altitude of 6,500 feet ; it communicates with the plains by a cart road about 30 miles in length ; it contains some hundreds of well-built houses. The principal masses of buildings are the north and south bazaars, which are situated at either end of a lake. The lake is surrounded on all sides, except at its southern end, where it overflows toward the plains, by a circle of hills, the highest points of which, such as Cheena and Ayapata, are more than 1,000 feet above the level of the lake. Upon the inner slopes of these hills most of the larger houses are situated. Without detailed reference to the history of Naini Tal we may say briefly that practically the whole cantonment has come into being within the last hundred years. A century ago there was probably a small hamlet or two on the shores of the lake, the inhabitants of which held very occasional intercourse with the plainsmen. The rat population of Naini has grown to its present condition in even measure with the growth of the town. If we speculate as to how they came to be as we find them, we may perhaps be inclined to some such explanation as the following. The white-tailed race are the original inhabitants, but the black-tailed rats are invaders from the plains which have established themselves in the central parts of the town and forced the others to occupy the more distant outlying houses. It may be supposed that the daily arrival of carts carrying stores from the plains is sufficient to explain how the supposed invasion was effected. In my opinion however this invasion hypothesis may be rejected for the following reasons:—Both classes of the Naini rats resemble one another and differ from the lowland rats in the quality of their fur and in having shorter tails. The two classes of Naini rats differ from one another as classes in the colour of the tail only and in no other respect. Individual specimens of either class might be captured and produced as evidence to show that this is an erroneous statement, but an inspection of even as few as ten of each class would, I feel sure, convince most people that this statement is correct. The essential facts of the case as they appear to me are as follows.—

- ¹ (1) There are, living in the same limited area apparently under the same conditions, two classes of animals which differ from one another in one obvious character only.
- (2) These two classes are segregative, *i.e.*, they live apart from one another.

If we enquire as to how this state of affairs came about, we shall best find the answer by considering the case of the white-bellied rats of Poona which differ from the common rats of that place in one character only (albiventrism) and are found apart from the common rats.

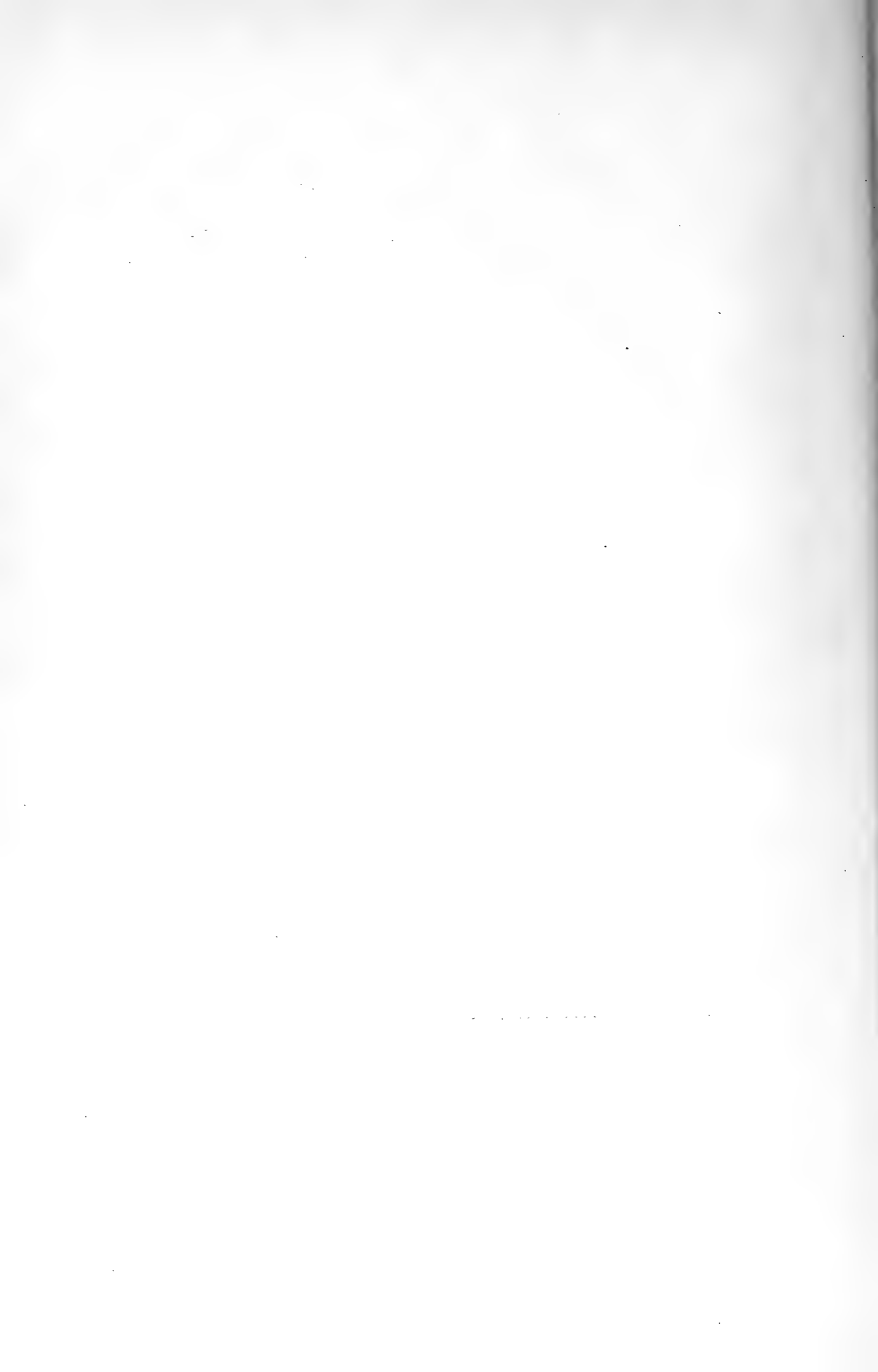
¹ See *The Zoologist*, (3), xv, p. 1, January 1891.

If we examine the two classes of Naini rats strictly from the point of view afforded by the theory of gametic factors, we must suppose that the Ayapata class are not all exactly alike in their gametic constitution. For example, among the twenty-seven rats of this class, which have been caught, are two specimens in which the dorsal pigment of the tail extends to the tip. These are, as regards tail coloration, exactly like the well-known species *Mus vicerex* of Kashmir and several other species of other places. I have had the opportunity of examining at least twenty specimens of *M. vicerex*. The tails of all of them are exactly like these particular two of the Ayapata race. If we are to explain the facts in terms of the theory, we must suppose that these two differ from the others of the Ayapata race but resemble the rats of Kashmir as regards that part of their gametic constitution which determines the pigmentation of the tail. These two were caught along with others of the Ayapata race, and it is almost certain that they are closely related by birth to them (*ibid.*, page 40). The tail of one of these rats is shown on plate ix (second from above).

Comparison between Indian and English Rats.

Through the kindness of the Curator of Zoology of the British Museum, I have had the opportunity of examining a brown and a black specimen of *Mus rattus* and a *Mus decumanus* which were caught in England. I can find no difference between them and Indian rats of the same species.

In conclusion, I must express my great obligations to Captain J. Kunhardt, I.M.S., who was in charge of the Plague investigations at Poona, and also to Colonel A. E. Ward for his kind help during my visit to Naini Tal.



EXPLANATION OF PLATE IX.

Above.—Litter of four young rats and an adult, which were caught at Poona. All of them have a white breast mark. The four young ones are of the same litter but it is uncertain whether the large one is their parent or not.

Below.—Tails of rats caught in Naini Tal. The uppermost is the tail of a common rat and is equally pigmented in its whole circumference. The second from above is pigmented in the whole of the dorsal surface. In the other four the dorsal pigmentation extends up to or not quite so far as the middle. The length of the hair is variable, and has not been studied.



Fig. 1.

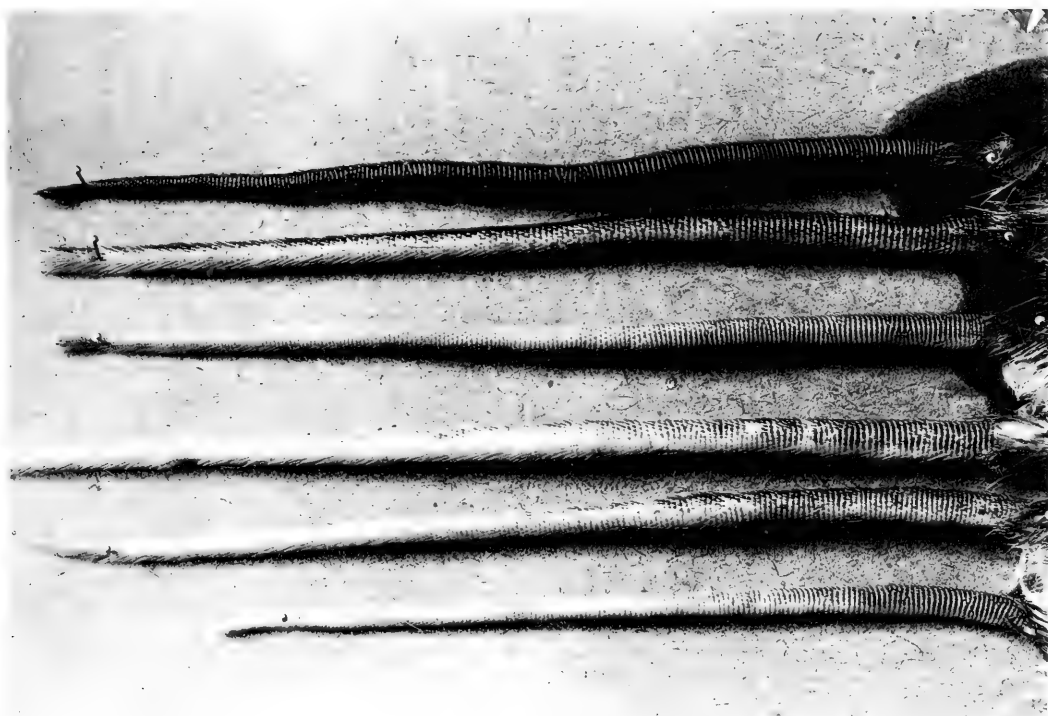


Fig. 2.

Benrose L^{td} Derby



EXPLANATION OF PLATE X.

The circular area marked off by a dotted line in the centre of the map is shown on a larger scale at the side. The circular black areas indicate the particular houses which are mentioned in the text.

CITY OF POONA

Scale 500 Yards = 1 Inch.





X. DESCRIPTION OF A NEW SPECIES
OF *SCALPELLUM* FROM THE
ANDAMAN SEA.

By N. ANNANDALE, D.Sc., Superintendent, Indian Museum.

The species of *Scalpellum* here described was taken by the R.I.M.S. "Investigator" in 1906. It belongs to the subgenus *Scalpellum*, if I am right in thinking that the genus as defined by Darwin should be subdivided into two subgenera, namely, *Smilium*, to include the more primitive forms, which have complementary males with well-developed mouth parts, alimentary system and cirri, and *Scalpellum*, the males of which are more or less sack-like and degenerate.

Scalpellum lambda, sp. nov.

CAPITULUM narrowly and somewhat irregularly ovate (the carinal margin being much more strongly curved than the occludent), laterally compressed, bearing fourteen imperfectly formed, thin, smooth, translucent valves, eight of which have the form of a Greek lambda.

PEDUNCLE shorter than the capitulum, cylindrical; rather slender, expanded at the base, armed with numerous narrow transverse plates arranged in alternating series.

VALVES. *Carina* arched, narrow; its umbo subterminal; its dorsum concave with clearly defined borders; its sides slightly convex outwards; its base not expanded; its apex almost in contact with the carinal margin of the terga, which extends above it for some distance. *Tergum* λ -shaped, with a prominent tooth on the carinal margin just above the point at which the apex of the carina approaches it; the carinal branch long and narrow, sloping gradually towards the carina; occludent branch stouter and much shorter, its tip overlapped by the apex of the scutum. *Scutum* shaped somewhat similarly, but with the occludent branch much stouter and with a vertical ridge running nearer to its lateral than its occludent margin. *Upper latus* also of a somewhat similar form; its carinal branch stouter and longer than its scutal one. *Carinal latus*, viewed from the side resembling the upper latus reversed, the fork of the λ pointing backwards and downwards instead of sloping upwards towards the occludent margin of the capitulum; the two carinal latera viewed from behind taking the form of a pair of small transverse isosceles triangles, which cover the base of the carina and are in close contact at their bases. *Inframedian latus*

irregularly triangular, the broadest part being the uppermost one. *Rostral latus* saddle-shaped, rather deep, its chief concavity being in the margin opposite the inframedian latus, with which it is almost in contact. *Rostrum* small, quadrangular, broader above than below.

APPENDAGES, etc. *First cirrus* rather long, widely separated from the second; the anterior branch longer than the posterior by nearly two joints and about half as broad as that branch in the middle; the hairs on both joints numerous and stout. The other cirri moderate, densely haired. *Anal appendages* slender, filiform, tapering, extending well beyond the junction of the rami of the sixth cirrus, having about eight joints, of which the second is much the shortest and the first the longest; the distal joint bearing at its tip two plumose bristles, of which the posterior is shorter; a similar bristle issuing from the posterior side of the inferior margin of the penultimate joint. *Penis* absent.

MOUTH PARTS. *Labrum* not bullate. *Outer maxilla* short and broad. Palp conical, with a few stout, short hairs at its apex. *Maxilla* narrow, with a shallow incisure near the centre of its free edge; external to the incisure two or three stout bristles and on its outer margin a much shorter one; internal to it five or six bristles of various sizes, their bases being on a lower level than those of the external bristles. *Mandible* with four teeth including the inner angle; the outermost tooth slightly larger than the second and by no means widely separated from it; the two innermost teeth close together, the fourth being small and sharp, pectinate on its outer margin and bearing a row of short hairs on its inner margin.

Several specimens of this species were taken by the "Investigator" at Station 372 (Lat. $13^{\circ} 54' 15''$ N., Long. $94^{\circ} 02' 15''$ E.), at a depth of 643 fathoms.

S. lambda is closely related to *S. curiosum*, Hoek, from which it may at once be distinguished by the form assumed by the bases of the carinal latera as viewed from behind and by that of the carina as viewed from the side.

XI. DESCRIPTIONS OF FIVE NEW SPECIES OF MARINE SHELLS FROM THE BAY OF BENGAL.

By H. B. PRESTON, F.Z.S.

Drillia ganjamensis, sp. nov.

Shell elongately fusiform, shining, white, stained, especially on the latter half of the last whorl, with chestnut; whorls 11, the first two smooth, painted with a spiral, chestnut band, the remaining whorls faintly, distantly, spirally striate, and sculptured with coarse, wavy, sub-nodulous, transverse costæ, lower half of last whorl and base of shell somewhat coarsely, spirally ridged; sutures lightly impressed; columella somewhat broadly expanded,

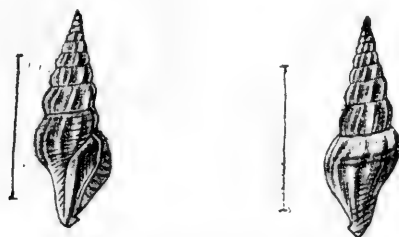


FIG. 1.—*Drillia ganjamensis*, sp. nov.

elongate, descending vertically, spreading above into a coarse, thick, well-defined, whitish callus; labrum acute, erect, vari-
cosely thickened behind; sinus broad, but not deep; aperture
elongate, narrow; canal recurved.

Altitude ..	..	18.25 mm.
Diam., major ..	..	6 ..
„ minor ..	..	4.75 ..
Aperture, alt. ..	..	5.25 ..
„ diam. ..	..	1 ..

Hab.—Ganjam Coast, Madras Presidency, 24—30 fathoms.
R. F. Trawler “Golden Crown.”)

Type in Indian Museum (Reg. No. M. $\frac{4672}{1}$).

Nassa ariel, sp. nov.

Shell small, acuminate ovate, yellowish white, stained and narrowly banded with pale reddish brown; whorls 8, the first three convex, smooth, the remainder flattish, shouldered above, sculptured with fine, spiral striæ, crossed by coarse, smooth, closely-set, transverse costulæ, a single, very narrow, incised, spiral groove appearing on the upper portion of the whorls; base of shell bearing six coarse, spiral grooves; sutures well-impressed; perforation barely perceptible, almost concealed by the reflexion of the columella; columella reflexed, white, polished, slightly excavated above, strongly, spirally grooved below, diffused into a thin, ill-defined callus which reaches the lip above and bears an elongate denticle situate just below the point of insertion of the labrum with the whorl above; labrum varicosely thickened, bearing a number of very elongate, closely-set denticles which run some distance into the interior of the shell; aperture irregularly ovate; canal somewhat broad.

Altitude ..	..	7.25 mm.
Diam., major ..	..	4 ,,
„ minor ..	..	3.5 ,,
Aperture, alt. ..	..	2.25 ,,
„ diam. ..	..	1 ,,

FIG. 2.—*Nassa ariel*, sp. nov.

Hab.—Balasore Bay. (B. F. Trawler “Golden Crown.”)
Type in Indian Museum (Reg. No. M. $\frac{4679}{1}$).

Pteronotus annandalei, sp. nov.

Shell fusiform, pale reddish brown, painted with indistinct bands of chestnut; bearing throughout the entire length three foliaceous varices, the first two of which are produced into hollow spines below; remaining whorls $9\frac{1}{2}$, presenting an almost scabrous appearance, sculptured with fine beaded striæ and transverse nodulous costæ; sutures impressed, coarsely and distantly crenellated by the apices of the transverse costæ; columella slightly curved, white, expanded; the margin almost erect and extending above into a thick, shining, well-defined white callus, bearing an

indistinct nodule above; labrum nearly continuous, reflexed, whitish, with three very distant chestnut spots, the result of the termination of the colour bands; aperture oval, a notch appearing at the point of contact of the outer lip with the parietal wall; canal elongate, closed, anteriorly recurved.

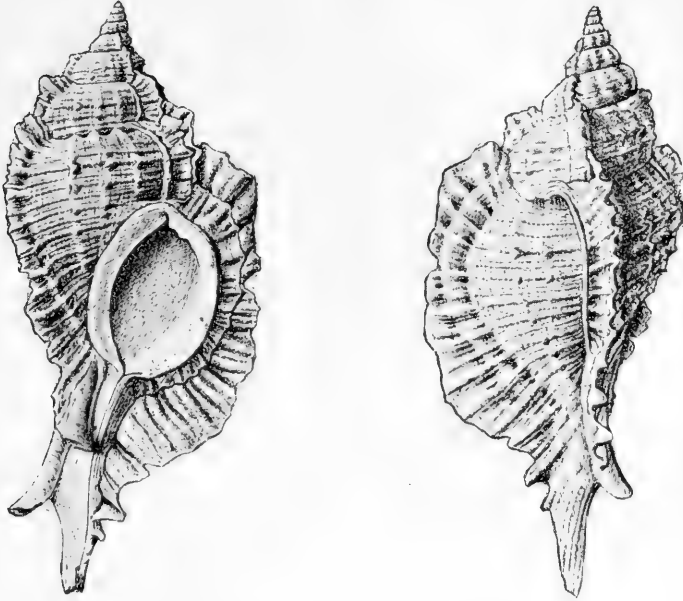


FIG. 3.—*Pteronotus annandalei*, sp. nov.

Altitude ..	..	76.5 mm.
Diam., major ..	..	32 „
„ minor ..	..	25 „
Aperture, alt. ..	..	21 „
„ diam. ..	..	14 „

Hab.—Off Gopalpore, 30—38 fathoms. (B. F. Trawler “Golden Crown.”)

Type in Indian Museum (Reg. No. M. $\frac{4708}{1}$).

A very handsome species which is easily separable from other members of the group by its graceful form combined with the curiously nodulous sculpture; owing to the chipping away of part of the foliaceous venter behind the aperture, the measurement of the greatest diameter quoted above must be considerably greater in a perfect specimen.

Martesia delicatula, sp. nov.

Shell irregularly rhomboidal, widely gaping anteriorly, pure white, thin; both valves anteriorly swollen, depressed towards the

middle and bluntly produced posteriorly, sculptured with distant, sinuous, concentric, very slightly foliaceous ridges, between which occur delicate, concentric striæ, and crossed anteriorly by radiate beaded ridges, the terminations of which project beyond the ventral



FIG. 4.—*Martesia delicatula*, sp. nov.

margin; umbones rather large and prominent; dorsal margin notched just behind the umbones, then abruptly rounded; ventral margin excavated anteriorly, rounded posteriorly; anterior side descending obliquely, angled below; posterior side bluntly rostrate; interior of shell white, polished, showing the sculpture through the thin shell.

Long.	..	..	5.25 mm.
Lat.	..	..	9.75 ..

Hab.—Mouth of the Devi River, Orissa Coast, 23—25 fathoms, in sodden wood. (B. F. Trawler “Golden Crown.”)

Type in Indian Museum (Reg. No. M. $\frac{4687}{1}$).

Pandora perangusta, sp. nov.

Shell small, white, depressed, curved, elongate-lunate; right valve concentrically striate with lines of growth, depressed towards the ventral margin, bearing two rather coarse, elongate carinæ dorsally and towards the posterior side, the space between these being at frequent intervals marked with transverse ridges; left valve not very convex, concentrically striate with two similar carinæ to those on the right valve; umbones small, not prominent; dorsal margin curved posteriorly, sloping anteriorly; ventral



FIG. 5.—*Pandora perangusta*, sp. nov.


margin rounded; anterior side angular above, descending obliquely below; posterior side elongately, posteriorly rostrate.

Long.	..	..	5	mm.
Lat.	..	..	12'5	,,

Hab.—Off the Devi River, Orissa Coast, 17—20 fathoms.
(B. F. Trawler “Golden Crown.”)

Type in Indian Museum (Reg. No. M. $\frac{4686}{1}$).

A pretty little species whose exceedingly narrow form and depressed appearance at once differentiates it from any others of the genus.





XII. NOTES ON FISH FROM INDIA AND PERSIA, WITH DESCRIPTIONS OF NEW SPECIES.

By J. T. JENKINS, *B.Sc. (Lond.), D.Sc. (Wales), etc.*,
Superintendent, Lancashire and Western Sea Fisheries.

I.—ON A COLLECTION OF FISHES MADE BY W. T. BLANFORD IN 1872 IN PERSIA AND BALUCHISTAN.

In 1872 Mr. W. T. Blanford accompanied Major St. John in a journey from Gwadar on the shores of the Arabian Sea to Shiraz, Isfahan and Tehran,¹ during which collections of zoological material were made. The reports on the Mammalia, Aves, Reptilia and Amphibia were shortly afterwards published,² but the collections of fish and invertebrata, "being comparatively few in number," have apparently never yet been worked out. The present collection, which is only a part of that which Blanford made, was procured partly in what is now British Baluchistan and partly in Persia proper.

The specimens of *Scaphiodon* are from Baluchistan, some being from a stream near the fort of Gishtigan in the Bampusht highland. Gishtigan is on the Kulushta river which drains south through the Nihing river into the Dashti and so into the Indian Ocean. Other examples of *Scaphiodon* are labelled Baluchistan simply, while still others are from a stream running into the desert at Kalagan at a height of 3,500 feet. The Cyprinodontidæ are all from the vicinity of Shiraz, in Southern Persia.

Although collected in 1872 the specimens do not appear to have reached the Indian Museum at Calcutta until 1881, at any rate they were not entered in the register until May of that year. No less than 91 specimens were then entered (Nos. 9341—9431, inclusive); of these 62 have been examined (Nos. 9392—97, 9402—4, 9408—18, 9425—31; 9419—24, 9363—76, 9377—91).

The first 27 specimens had been carefully wrapped up in linen and preserved in spirit and they are now, after thirty-seven years, in a remarkably good state of preservation. The remaining 35 were loose in spirit and, although capable of being identified, were not nearly as well preserved as the others. They consist almost entirely of the new species of *Scaphiodon* except that there are a few

¹ *Eastern Persia: An account of the journeys of the Persian Boundary Commission, 1870-71-72*, vol. i, Geography, p. 18, *et seq.* (London, Macmillan & Co., 1876).

² *Ibid.*, vol. ii, Zoology and Geology, by W. T. Blanford.

Discognathus lamta and one imperfect specimen of *Cyprinodon blanfordii*. All the specimens are Cyprinidæ and belong to the genera *Scaphiodon*, *Cyprinodon* and *Discognathus*. The specimens of *Scaphiodon* differ from those previously described and are here recorded as a new species.

Scaphiodon baluchiorum, sp. nov. (Pl. vi, fig. 1.)

D. 3—9-10, V. 8, A. 8-9, P. 16, C. 10. L.l. 37-39, L.tr. $6\frac{1}{2}$ - $3\frac{1}{2}$.

Length of head $5\frac{1}{2}$ times and height of body $4\frac{1}{2}$ times in total length (including the caudal fin). Snout obtuse, covered with glandular pores. Diameter of eye $3\frac{1}{4}$ times in length of head. Interorbital width $2\frac{1}{3}$ times in length of head. Mouth inferior, upper jaw the longer.

Barbels, a maxillary pair, about half the length of the eye. Dorsal fin commencing slightly before ventrals, its third undivided ray osseous and posteriorly serrated in its lower half. Height of dorsal fin about $\frac{3}{4}$ that of body. Pectoral shorter than head. Well-marked tubercles on rays of anal fin occasionally present (absent in the specimen figured). Caudal forked, upper lobe the longer.

Scales regularly arranged, in this respect differing from *S. irregularis* (Day); on lower surface of body small and rudimentary. Dorsal and lateral scales with fine black dots, especially on lateral surface of body.

Colour (in spirit) greyish above gradually fading to silvery below.

Localities.—Gishtigan (Bampusht); Kalagan, 3,500 feet; Baluchistan.

Cyprinodon blanfordii, sp. nov. (Pl. vi, fig. 3.)

D. 9, V. 5, A. 8, P. 16, C. 24. L.l. 32, L.tr. 13.

Height of body 3.4 times, length of head 3.8 times, in total length inclusive of caudal. Snout obtuse, truncated, mandible directed vertically upwards. Diameter of eye twice length of snout and one-third length of head. Interorbital space slightly wider than diameter of eye.

Origin of dorsal fin much further from tip of snout than from root of caudal. First anal ray below fourth dorsal.

Colour.—Body dark brown above fading to pale yellow below. Fins colourless. Operculum and head below eyes with minute black spots. A series of black spots more or less longitudinally arranged along sides of body, with a larger lozenge-shaped spot near root of tail. In these specimens, which have been in spirit for over 30 years (although to some extent protected from the light, owing to their being wrapped up in linen), the colour must necessarily have changed considerably.

Locality.—East of Shiraz, South Persia (Reg. Nos. 9416—18).

This species somewhat resembles *Cyprinodon punctatus*,¹ a form identical with the *Lebias punctatus* of Heckel² which was recorded from Nemek-Deria, a salt-water lake near Shiraz. The number of rays in the dorsal and anal fins, the number of lateral line scales and in particular the number of lateral transverse rows of scales differentiate *C. blanfordii* from *C. punctatus*.

Cyprinodon persicus, sp. nov. (Pl. vi, fig. 4.)

D. 9, V. 4, A. 9, P. 15, C. 27. L.l. 29, L.tr. 14.

Height of body 3.5 times, length of head 3.7 times, in total length inclusive of caudal.

Body elevated and compressed. Snout obtuse, mandible directed upwards. Diameter of eye $1\frac{2}{3}$ length of snout and $2\frac{1}{5}$ in length of head. Interorbital space broad, not less than one and a half times diameter of eye. Origin of dorsal much nearer to root of caudal than to eye and situated considerably behind the vertical from the root of the ventral, which is half-way between the tip of the snout and the base of the caudal.

Colour (in spirit).—The head and body are both light brown in colour. Along the body there is a number (10) of vertical white stripes, running from the ventral surface to just below the dorsal margin. The operculum is unspotted. The dorsal fin is blackish except at the margin and base, both of which are whitish. The other fins are pale yellow. In one of the two specimens there is a pale band running across the snout between the eyes.

Locality.—Spring on the edge of Shiraz Lake, Southern Persia (Reg. Nos. 9403-4).

This species comes near *Cyprinodon sophiæ*³ (*Lebias sophiæ* of Heckel), but differs from it in the number of fin rays and lateral line scales. The lateral transverse row is 7 in *C. sophiæ*, whereas in *C. persicus* it is 14. The origin of the dorsal fin is also markedly different in the two species; in *C. sophiæ* it is midway between the root of the caudal and the eye, whereas in *C. persicus* it is much nearer the former.

Cyprinodon pluristriatus, sp. nov. (Pl. vi, fig. 5.)

D. 11, V. 6, A. 12, P. 15, C. 28. L.l. 29-31, L.tr. 14.

Height of body 3.5 times in length of head and 4 in total length inclusive of caudal.

Body elevated and compressed, snout obtuse. Diameter of eye nearly equal to length of snout. Interorbital space about $1\frac{2}{3}$ diameter of eye. Origin of dorsal much nearer to root of caudal than to eye.

¹ See Günther's Catalogue, vol. vi, p. 305.

² In *Russeger, Reisen*, ii, 3, p. 268, taf. 22, fig. 3 (quotation taken from Günther).

³ See Günther's Cat., vol. vi, p. 304.

Colour (in spirit).—The head and body are of a dark brown colour. Along the sides of the body there is a number of vertical white stripes, running from the ventral surface to just below the dorsal. The number is greater than in *C. persicus*, being from 14 to 16. The operculum has a number of small brownish spots irregularly arranged. The fins are yellowish brown and, except the pectoral and pelvic, are white-edged. The lower edge of the pectoral is tinged with black.

Locality.—East of Shiraz, stream running to Fussa, Southern Persia, 5,000 feet (Reg. Nos. 9408—12).

This species is allied to the previous one, *C. persicus*, but is readily distinguished by the greater number of vertical white bands. In *C. pluristriatus* these bands are appreciably narrower than in *C. persicus*. The fin ray formula also differs in the two species.

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- Cuvier et Valenciennes .. *Histoire naturelle des poissons*, 1844,
vols viii, xiv, xvi.
Fillippi, F. de .. "Nuove specie di Animali raccolte in
un viaggio in Persia," *Arch. per la*
Zool., ii, 1863.
Fillippi, F. de .. *Note di un Viaggio in Persia*, Milan,
1865.

Gives list of vertebrata, including twenty-two fishes, of which ten are described as new species, namely, *Gobius macrobus*, *Systomus alpinus*, *Barbus cyri*, *Barbus miliaris*, *Abramis microlepis*, *Squalius turcicus*, *Telestes leucoides*, *Alburnus eichwaldii*, *Alburnus doriae* and *Acanthopsis aurata*.

Some of these fish are not Persian in the sense that they were found within the boundaries of Persia as at present constituted.

- Güldenstadt .. "Cyprinus capoeta et Cyprinus
mussa," *Nov. Comm. Petropol.*,
xvii, 1773, p. 507, pls. viii, ix.
Günther, A. .. *British Museum Catalogue of Fishes*,
vols. iii, v, vi, vii, 1868.
Günther, A. .. *Zoology of the Afghan Delimitation*
Commission, second series, vol. v,
1887, Fishes.

Describes a new species of *Cirrhitina*, *C. afghana*, which occurs in N. Baluchistan, also a new species of *Schizothorax*, *S. rawlinsii*, from Bard,

Province of Khorassan, Persia. Also *Nemachilus kessleri* from Nushki, N. Baluchistan.

- Heckel, J. "Ichthyologie," *Russeger, Reisen in Europa, Asien und Afrika*, 1841-43, vols. i and ii, Stuttgart, 1843.
(I have not been able to see this work but all the fish appear to be mentioned in Günther's Catalogue.)

Describes (amongst others) *Cyprinodon sophiæ*, *Cyprinodon punctatus*, *Barbus barbatus*, *Cobitis persa*, *Acanthopsis linea*.

- Kessler, K. *Mém. Soc. Nat. St. Petersburg*, t. vii.
Keyserling, Graf E. "Neue Cypriniden aus Persien," *Zeitschrift ges. Naturwiss.*, Berlin, xvii (1861).

Describes the following as new species:—*Barbus microlepis*, *Scaphiodon chebisiensis*, *Scaphiodon rostratus*, *Scaphiodon gracilis*, *Scaphiodon heratensis*, *Scaphiodon asmussi*, *Alburnus maculatus*, *Bungia nigrescens*, *Squalius latus*. All these species are figured. *Scaphiodon macrolepis*, Heck., and *Discognathus variabilis*, Heck., are also recorded. Contains also a table for the determination of the species of *Scaphiodon*.

- Ménétriés, E. *Catalogue Raisonné des Objets de Zoologie recueillis dans un voyage au Caucase et jusqu'aux frontières actuelles de la Perse*, St. Petersburg. Imprimerie de l'Académie Impériale des Sciences, 1832.

Enumerates 38 species of fish, most if not all of which are outside the confines of Persia.

- Nikolski, A. M. "Reptiles, Amphibiés et Poissons, recueillis pendant le voyage de M. N. A. Zaroudny en 1898 dans la Perse," *Ann. du Mus. Zool. de l'Acad. Imp. des Sciences de St. Petersbourg*, tome iv, 1899, p. 375.

Records following species from Persia:—*Ophiocephalus gachua*, *Cyprinodon dispar*, *Capocta amir*, *Schizothorax poelzami*, *Schizothorax zaroudnyi*, *Cirrhinia afghana*, *Discognathus lamta*, *Discognathus variabilis*.

Also describes as new *Barbus bampurensis* from Bampur River, *Cyprinion kirmanense* from Schur-Ab in Kirman, *Nemachilus bampurensis* from Barmau and *Nemachilus sargadensis* from Sargado. None of these are figured.

- Sauvage . . . "Notice sur la faune ichthyologique de l'ouest de l'Asie et plus particulièrement sur les Poissons recueillis par M. Chantre pendant son voyage dans cette region," *Nouvelles Archives du Muséum*, 2e serie, t. vii, 1884.
Gives a list of fishes recorded from Western Asia.
- Steindachner, F. . . "Ichthyologische Mittheilungen" (vii), *Verh. zool.-bot. Ges. Wien*, 1864, pp. 223—234.
Unites *Scaphiodon capoeta* and *S. socialis* of Heckel into one species under the former name.

II.—FISHES FROM PARESNATH HILL, W. BENGAL.

Five species of fish were collected at Paresnath Hill by Dr. Annandale and myself in April 1909. They were obtained from a stream known as Sita Nullah at a height of 2,150 feet.

The specimens belong to three families, *viz.*—

SILURIDÆ.

Glyptosternum saisii, sp. nov.

CYPRINIDÆ.

COBITIDINÆ.

Nemachilus savona.

CYPRININÆ.

Discognathus lamta.

Danio dangila.

OPHIOCEPHALIDÆ.

Ophiocephalus gachua.

Glyptosternum saisii, sp. nov. (Pl. vi, fig. 6.)

D. 1-6, V. 6, A. 10, P. 1-7, C. 14.

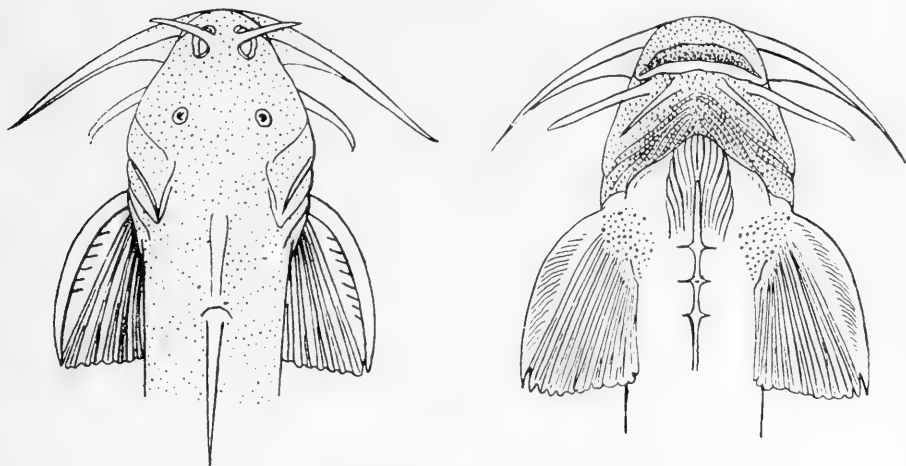
Length of head $4\frac{1}{2}$ times, of caudal $6\frac{3}{4}$ times, height of body $6\frac{1}{2}$ times, in total length. Eyes approximately in mid length of

head, width of interorbital space $3\frac{1}{2}$ times in length of head. Upper jaw the longer, the width of the gape of the mouth $2\frac{1}{3}$ times in the length of the head. Lips slightly fringed.

The maxillary barbels extend to just beyond the base of the pectoral fins, the nasals reach about three-quarters of the way to the orbit, the outer mandibular to the base of the pectoral and the inner to the gill opening. Teeth in the jaws villiform, palate edentulous.

Dorsal fins as high as body. Bases of adipose and first dorsal fins approximately equal, pectoral extending half-way to ventral. Pectoral spine flattened, strong, and coarsely serrated internally. Skin covering under surface of pectoral and ventral spines plicated.

Colour.—Greyish black all over except ventral thoracic and



Glyptosternum saisii, sp. nov., $\times 2$.

abdominal regions which are whitish. Fin membranes white, rays and spines black. Caudal fin with black spots. Caudal peduncle twice as long as high.

This species approaches *G. pectinopterum*, McClelland, a form which occurs in the Himalayas, throughout the Punjab, and at Kangra, Simla and Darjiling, but differs from it in the head being longer than broad, and in the adhesive apparatus being much longer than wide. The relative body proportions are also markedly different.

III.—TWO NEW SPECIES OF *Cynoglossus* FROM THE SUNDERBUNS.

While engaged in an enquiry into the fishery resources of the Sunderbuns, trawling was tried in several of the creeks. On the 25th August 1909, when fishing with the shrimp trawl off Morelganj

(in the district of Khulna) in 10 fathoms water, two species of *Cynoglossus* were obtained which are here described as new.

Cynoglossus acinaces, sp. nov.

D. 168-182, V. 5, A. 120-125, C. 12. L.l. 129-133.

Two lateral lines on coloured side, one on blind side. Scales between lateral lines on left side, where widest apart, 13. Length of head $5\frac{1}{4}$ times, height of body 7 times, in total length. Eyes in middle of head; diameter 16 to 17 times in length of head; upper slightly in advance of lower and about $\frac{1}{2}$ diameter apart. Cleft of mouth extending well behind posterior edge of eyes. Scales markedly ctenoid on coloured side, cycloid on uncoloured side.

Colour.—Pale greyish white.

This species comes nearest to *C. elongatus*, Günth., and to *C. lingua*, Ham. Buch. It however differs from both in the much larger number of rays in the dorsal and anal fins and in the greater slenderness of the body.

Cynoglossus deltæ sp. nov.

D. 95, V. 4, A. 70. L.l. 90.

Two lateral lines on the coloured, one on the blind side.

Scales on left side between lateral lines, where widest apart, 12. Length of head nearly 5 times, height of body 4 to 4.3 times, in total length. Eyes in anterior half of head; diameter 22 times in length of head; upper partly in advance of lower and a diameter apart. Cleft of mouth extending well behind posterior edge of eyes. Scales ctenoid on both sides.

Colour.—Pale yellow.

This species comes nearest to *C. lida*, Bleek., and *C. bengalensis*, Bleek. It differs from the latter in that its ventral fin is separate from the anal, and in its body being somewhat more slender. From *C. lida* it is differentiated by the smaller number of rays in the dorsal and anal fins.

IV.—ON A COLLECTION OF FISH FROM KARACHI, WITH A DESCRIPTION OF TWO NEW PLEURONECTIDS.

This collection of fish was obtained by purchase from Karachi in 1908 (February to May). Most of the specimens were bought in the markets, but in a few instances inedible species were collected from the fishermen. For the most part the collection consists of common species. The Pleuronectidæ comprise two forms which are here described as new. The arrangement adopted is that of Day as being the most convenient for reference. All the fish were Teleosteans.

Physostomi.**SILURIDÆ.**

Arius dussumieri.

CLUPEIDÆ.

Clupea brachysoma.

„ *lile.*

„ *longiceps.*

„ *sindensis.*

Chatoessus nasus.

„ *chacunda.*

Chanos salmoneus.

SCOMBRESOCIDÆ.

Belone strongylura.

Acanthopterygii.**PERCIDÆ.**

Lates calcarifer.

Serranus diacanthus.

„ *lanceolatus.*

Lutjanus johnii.

„ *lioglossus.*

Apogon bifasciatus.

Therapon quadrilineatus

„ *jarbua.*

„ *puta.*

Pristipoma hasta.

Diagramma cinctum.

Gerres lucidus.

SQUAMIPINNES.

Scatophagus argus.

Drepane punctata.

SPARIDÆ.

Pagrus spinifer.

Chrysophrys berda.

„ *datnia.*

„ *sarba.*

TEUTHIDÆ.

Teuthis oramin.

POLYNEMIDÆ.

Polynemus tetradactylus.

SCIÆNIDÆ.

Otolithus ruber.

Sciæna belengeri.

„ *cuja.*

CARANGIDÆ.

- Caranx gallus.*
,, *hippos.*
,, *rottileri.*
,, *sansun.*
Chorinemus moadetta.
,, *toloo.*
Trachynotus ovatus.
Equula brevirostris.
,, *fasciata.*
,, *insidiatrix.*

SCOMBRIDÆ.

- Cybium commersoni.*
Elacate nigra.

TRACHINIDÆ.

- Sillago sihama.*

BATRACHIDÆ.

- Batrachus grunniens.*

COTTIDÆ.

- Platycephalus insidiator.*

GOBIIDÆ.

- Periophthalmus koelreuteri.*

SPHYRÆNIDÆ.

- Sphyræna jello.*

MUGILIDÆ.

- Mugil carinatus.*
,, *cunnesius.*
,, *kelaartii.*
,, *klunzingeri.*

GLYPHIDODONTIDÆ.

- Pomacentrus sindensis.*

Anacanthini --

PLEURONECTIDÆ.

- Synaptura orientalis.*
Pseudorhombus arsius.
Cynoglossus puncticeps (?).¹
Solea sindensis, sp. nov.
Plagusia obscura, sp. nov.

¹ The specimen is somewhat damaged and has not the markings of *puncticeps*, but the colour has possibly been dissolved out in spirit.

Solea sindensis, sp. nov.

D. 70, V. 4, P. 8, A. 50. L.l. 120.

Length of head 6 times, height of body 2·8 times, in total length, inclusive of caudal fin. Eyes about $\frac{1}{2}$ diameter apart; diameter $4\frac{3}{4}$ times in length of head; lower eye $1\frac{1}{4}$ diameters from end of snout. Nasal opening on coloured side immediately in front of lower eye, not situated on a papilla; that on blind side circular.

Scales ctenoid on both sides of body. Pectoral fin on coloured side with a black blotch on its outer third. Numerous short tentacles on anterior portion of head on blind side.

Colour.—Dark brown on coloured side with dark spots scattered over head, body and fins.

The genus *Solea* has, so far as I am aware, only once been recorded from the north-eastern part of the Arabian Sea. A specimen was obtained by the "Investigator" off the Kattiarwar coast at a depth of 82 fathoms. This specimen is referred to a species described as *Solea umbratilis* by Alcock,¹ but is figured in the same paper and also in the *Illustrations of the Zoology of the Investigator*² as *Solea umbratilis*. The first name is so obviously due to a printer's error that one naturally refers to the species as *umbratilis*.

The species described above was obtained from Karachi market and is therefore certainly a shallow water form; it comes nearest to *S. ovata*, whereas *S. umbratilis* is a deep-sea form.

Synopsis of the Indian species of Solea.

- A. Both pectorals present.
 - a. Height of body less than 3 in total length.
 - (1) Height of body $2\frac{3}{4}$ in total length.
D. 70. L.l. 120 *S. sindensis*.
 - (2) Height of body $2\frac{1}{4}$ in total length.
D. 60-66. L.l. 110 *S. ovata*.
 - b. Height of body 3 or more in total length.
 - (1) Long tubular nostril. Body irregularly banded *S. heterorhina*.
 - (2) Short tubular nostril. Body with black blotches *S. elongata*.
- B. Pectoral wanting on left (blind) side .. *S. indica*.
- C. No pectorals.
 - a. Less than 85 rays in dorsal fin.
 - (1) D. 70, A. 50. Numerous large black blotches on coloured side .. *S. umbratilis*.
 - (2) D. 77, A. 54. Coloured side very dark olive. *S. cyanea*.

¹ *Journ. As. Soc. Beng.*, vol. lxiii, pt. 2, 1894, p. 131, pl. vii, fig. 3.² *Fishes*, pl. xv, fig. 4.

b. More than 85 rays in dorsal fin.

D. 98. Complicated ocelli on coloured surface *S. oculus*.

Plagusia obscura, sp. nov.

D. 94, V. 4, A. 80, C. 8. L. 1. 112.

Length of head $4\frac{1}{2}$ times, height of body 4 times, in total length, inclusive of the caudal. Eyes, 9 diameters in length of head, one diameter apart. Lips fringed. Nostril on coloured side small, that on blind side tubular and well developed. Two lateral lines on the coloured side separated where widest apart by 16 rows of scales. Scales ctenoid on both sides.

Colour dark brown, much darker than in *C. bilineata*. Each scale lightest in centre.

Length of specimen 15.9 cm.

This species differs from *P. marmorata* in the smaller number of dorsal and anal fin rays and the body coloration, while from *P. bilineata* it is distinguished by the number of scales between the lateral lines on the coloured side and by the proportion of the body height to the length.

Synopsis of the Indian species of Plagusia:

- A. Two lateral lines on coloured side separated by 16 or 17 rows of scales.
 - a. D. 99-106, A. 75-86. Body marbled .. *P. marmorata*.
 - b. D. 94, A. 80. Body not marbled .. *P. obscura*.
- B. Two lateral lines on coloured side separated by 13 or 14 rows of scales.
 - D. 96-102, A. 70-74. *P. bilineata*.

V.—A LIST OF FISHES FROM LAKE CHILKA, TOGETHER WITH A DESCRIPTION OF A NEW SPECIES OF *Gobius*.

The following list comprises two collections, one made by Mr. Hodgart, Museum collector, in the neighbourhood of Gopkuda Island in August 1907; the other by myself near Satpara in December 1908.

Satpara lies at the landward extremity of the narrow channel which connects Lake Chilka with the sea, whereas Gopkuda is far removed from the entrance.

On the way to the Lake (December 8th, 1908) three specimens of fish were purchased in the bazaar at Balgaon (B. N. Railway). These were identified as—

NOTOPTERIDÆ.

Notopterus kaptat.

GOBIIDÆ.

Gobius striatus.

OPHIOCEPHALIDÆ.

Ophiocephalus striatus.

In the following list of the lake fish the letter G indicates that the fish was caught near Gopkuda Island, while S indicates Satpara.

Elasmobranchii.

CARCHARIIDÆ.

Carcharias melanopterus. S.

MYLIOBATIDÆ.

Aëtobatis flagellum. S.**Physostomi.**

SILURIDÆ.

Macrones vittatus. S.*Osteogobius militaris.* S.

CYPRINIDÆ.

Barbus amphibius. G.

CLUPEIDÆ.

Clupea lile. G.*Chatoessus nasus.* G. S.*Elops saurus.* G. S.*Engraulis mystax.* G.,, *malabaricus.* S.

SCOMBRESOCIDÆ.

Belone strongylura. S.*Hemirhamphus limbatus.* S.

CYPRINODONTIDÆ.

Haplochilus panchax. G.,, *melanostigma.* G.**Acanthopterygii.**

PERCIDÆ.

Gerres lucidus. S.*Pristipoma hasta.* S.*Therapon jarbua.* S.,, *puta.* S.

SPARIDÆ.

Chrysophrys berda. G. S.,, *sarba.* G. S.

POLYNEMIDÆ.

- Polynemus tetradactylus.* G. S.
 „ *plebeius.* S.

SCIÆNIDÆ.

- Umbrina macroptera.* S
 „ *russellii.* G.
Sciæna albida. G.

CARANGIDÆ.

- Equula blochii.* S.
 „ *edentula.* G. S.
Caranx ire. G.
 „ *djedaba.* S.
Gazza æquiformis. S.
Psettus argenteus. S.

TRACHINIDÆ.

- Sillago sihama.* S.

GOBIIDÆ.

- Gobius chilensis*, sp. nov. G.

MUGILIDÆ.

- Mugil klunzingeri.* S.
 „ *oeur.* G. S.
 „ *olivaceus.* G.
 „ *seheli.* S.

Plectognathi.

SCLERODERMI.

- Triacanthus brevirostris.* G. S.

At Gopkuda purely freshwater species such as *Barbus amphibius*, *Haplochilus panchax* and *H. melanostigma* occur. These are not represented at Satpara.

In March 1909 trawling was carried on on the Bengal Government vessel the "Golden Crown" off the entrance to Lake Chilka in depths of about 27 fathoms on a muddy bottom.

On comparing the fish obtained in these hauls with those from the lake, one finds that there are four species common to the three lists, namely *Chatoessus nasus*, *Chrysophrys berda*, *Equula edentula* and *Triacanthus brevirostris*; while there are five other species found both in the sea off the lake entrance and at Satpara, but not at Gopkuda Island. These are *Umbrina macroptera*, *Caranx djedaba*, *Polynemus plebeius*, *Therapon jarbua* and *Pristipoma hasta*.

It is certainly rather curious that while purely marine forms were obtained together with freshwater species from Gopkuda, typical estuarine types such as *Osteogobius militaris* should not have been found there.

Several female specimens of *Haplochilus melanostigma* were obtained which were carrying a mass of eggs attached to the abdomen (see pl. vi, fig. 7). The average number of eggs so attached is from 30 to 36. These are affixed by a number of slender filamentous processes given off from a central ligament which protrudes from the external genital opening. Each egg is about a centimetre in diameter and the shell, which is quite distinct from the egg proper, has on its external surface a number of minute processes (see fig. 7a).

Gobius chilkensis, sp. nov. (Pl. vi, fig. 2.)

D. 15—17, P. 14, V. 1-4, A. 8, C. 28.

Length of head 6 times, of caudal fin $4\frac{1}{5}$ times, height of body $5\frac{1}{4}$ times, in total length. Eye-diameter equal in length to snout and interorbital space and $3\frac{1}{2}$ times in length of head.

Interorbital space slightly concave. Width of head $\frac{3}{4}$ of length, height also $\frac{3}{4}$ of length. Upper jaw the longer, cleft of mouth extending to middle of orbit. No canine teeth. Preopercle minutely serrated.

Spines in first dorsal fin variable. Posterior extension of 2nd dorsal and anal ray very variable, in some instances reaching nearly to origin of caudal. Caudal rounded.

Colour pale yellow, margins of scales black. Dorsal and caudal spotted in bands. Pectoral colourless. Ventral sometimes colourless, sometimes with black rays. Anal colourless, but membrane with minute black spots.

Locality.—Lake Chilka, Gopkuda Island.

This species comes near *G. giuris*, but differs in that the lower jaw does not project and in that the snout is not elongate. The posterior extension of the ventral is also much more marked in *G. giuris*. There are twelve specimens in the collection and their measurement in millimetres from the tip of the snout to the extremity of the tail is respectively 44, 42, 42, 41, 40, 39, 36, 32, 25, 21, 21 and 19.

VI.—SOME FISH FROM UPPER BURMA.

Two collections of Burmese fish have recently been added to the Indian Museum; one was purchased by Dr. Annandale in the market at Mandalay (March 1908), while the other was obtained by Mr. J. Coggin Brown of the Geological Survey of India at Bhamo, Upper Burma, in January 1909. Some of the specimens in the latter collection were obtained from a tank (T), others from the Irrawaddy River (R).

TELEOSTEI.

Physostomi.

SILURIDÆ.

Callichrous pabo. Mandalay.

Macrones cavasius. Mandalay.

Macrones bleekeri var. *burmanicus*. Bhamo (T)
Saccobranchus fossilis. Bhamo (T).

CYPRINIDÆ.

Rohtee belangeri. Mandalay.
Cirrhhina mrigala. Mandalay.
Nuria danrica var. *alta*. Mandalay. Bhamo (R).
Rasbora daniconius. Bhamo (R).
Barbus tetrapogon. Bhamo (R).

COBITIDINÆ.

Lepadocephalichthys guntea. Mandalay.

CLUPEIDÆ.

Clupea variegata. Mandalay.

NOTOPTERIDÆ.

Notopterus kaptat. Mandalay.

Acanthopterygii.

PERCIDÆ.

Ambassis baculis. Mandalay.
 „ *ranga*. Bhamo (R).

RHYNCHOBDELLIDÆ.

Mastacembelus zebrius. Mandalay.

OPHIOCEPHALIDÆ.

Ophiocephalus marulius. Mandalay.
 „ *punctatus*. Bhamo (T).

LABYRINTHICI.

Anabas scandens. Bhamo (T).

Of the above *Barbus tetrapogon* and *Lepadocephalichthys guntea* have not previously been recorded from Burma though their distribution in India is wide.

VII.—THE SPAWNING OF THE HILSA.

During 1909 I was able to examine Hilsa (*Clupea ilisha*) at various places in the province of Bengal. Unfortunately, through circumstances over which I had no control, the investigation into the spawning habits of this fish was suspended at a time when it seemed probable that its spawning grounds would be located. The results of the investigation are appended here for the benefit of anyone who may care to follow up the question.

There can be no doubt whatever that the Hilsa, like the American and European “Shad” (*Clupea sapidissima* and *C. alosa* and *finta*), is an anadromous fish, that is, it ascends the rivers from the sea in order to spawn. The spawning places and habits of the

American Shad (*C. sapidissima*) are now well known¹ and artificial hatching of this fish is extensively practised in the United States. Nothing is known of the details of the spawning of the European Shad (*C. alosa* and *finta*)² or the Indian Hilsa. Recently the ripe eggs of the Hilsa have been obtained in the Madras Presidency by Mr. Wilson of the Madras Fisheries, but so far as one can ascertain they were not obtained on the natural spawning grounds, but at a weir which dammed up the stream and so prevented the upward migration of the fish. The diameter of the eggs is not given.

In Bengal it appears that the Hilsa move up the rivers in the rains and down towards the sea on their return journey from December to February. Spent Hilsa are abundant in Lake Chilka in December. Since they are full of roe in the rains and spent from December to February, it follows they must have deposited their spawn in the rivers.

Adult fish were examined between the middle of June and the 8th October. From the 17th to 21st June specimens were obtained in the Calcutta markets and examined in the Museum. These fish were from Sara Ghat (in the province of Eastern Bengal and Assam). The males even at this period of the year had ripe spermatozoa but no female was obtained either ripe or spent. Eggs from the females were examined in normal salt solution and the diameter of the eggs was found to be 0.5 mm.

Subsequently visits were paid to Sara Ghat, Rajmahal, Khulna, Bagherhat, Monghyr and Kooshtea in the order named and live fish were examined and search made as far as practicable, with a fine-meshed net, along the banks of the river for the fry of the Hilsa.

In the following table the diameter of the eggs, and the condition of the reproductive organs of the males at each of the above-mentioned places is shown:—

Place.	Date.	Average diameter of eggs in mm.	Condition of testes.
Sara Ghat ..	June 25 ..	0.66	..
Rajmahal ..	July 5—7 ..	0.6	Ripe.
Hooghly at Calcutta ..	Aug. 20 ..	0.4	..
Khulna ..	Aug. 23 ..	0.59	..
Bagherhat ..	Aug. 25 ..	..	Immature.
Monghyr ..	Sep. 22—25 ..	0.68	Ripe.
Kooshtea ..	Oct. 7—8 ..	0.68	Ripe

¹ See J. A. Ryder, *Rep. U. S. Fish Comm.* for 1885, No. 13, pp. 523—533, pls. xiv—xxii, 1887.

² But see P. P. C. Hoek, *Tijdschrift d. Nederlandsche Dierkund. Vereeniging.*, Leiden, 1888, Supplem. deel ii, pp. 313—17, taf. vi, figs. 6—8 (young stages of *C. alosa*), and E. Ehrenbaum, *Wissenschaft. Meeresuntersuch. Anst. Helg.*, Bd. i, S. 54—63, taf. ii, figs. 9—15, 1894. P. P. C. Hoek, *Verlag v. d. staat. d. niederlandische Zeevischerijen* over 1896. Bijlage v. Rapport over het visschen met Ankerkuilen bes. p. 290, ff., pls. ii—iv (young of *C. alosa* and *C. finta*).

A few females purchased in Calcutta on September 14th and alleged to be from Goalundo had eggs of the average diameter of 0.58 mm. At Monghyr a spent female was obtained on September 23rd. In the ovary of this fish were a few large dead eggs which had escaped extrusion in the spawning act. These eggs measured 0.9 mm.¹ (The egg diameter of the American Shad after extrusion is given as $\frac{1}{14}$ of an inch, approximately 1.8 mm.) The egg membrane in all probability expands in contact with water, so the egg of *Clupea ilisha* may approximate in diameter to that of the American Shad.

At Rajmahal a careful search was made along the banks of the Ganges for Hilsa fry but none were obtained. The young of the following species were identified:—*Wallago attu*, *Mugil corsula*, *Pseudentopuis garua* and *Haplochilus melanostigma*.

At Monghyr a quantity of undersized fish was obtained from the market and identified. The following species were present:—*Gobius giuris*, *Engraulis telara*, *Barbus sarana*, *Rohtee cotio*, *Silundia gangetica*, *Ailia coila*, *Wallago attu*, *Macrones cavasius*, *Pangasius buechanani*, *Bagarius yarrellii*, *Macrones aor*, *Sciænoides pama* and *Clupea chapra*. A single specimen of the Hilsa (*Clupea ilisha*) 6 cm. long was obtained. It would appear that the Hilsa spawns in the Ganges somewhere above Monghyr and careful investigation should be carried on during September and October in suitable localities above that place.

VIII.—PARENTAL CARE IN SILURIDÆ.

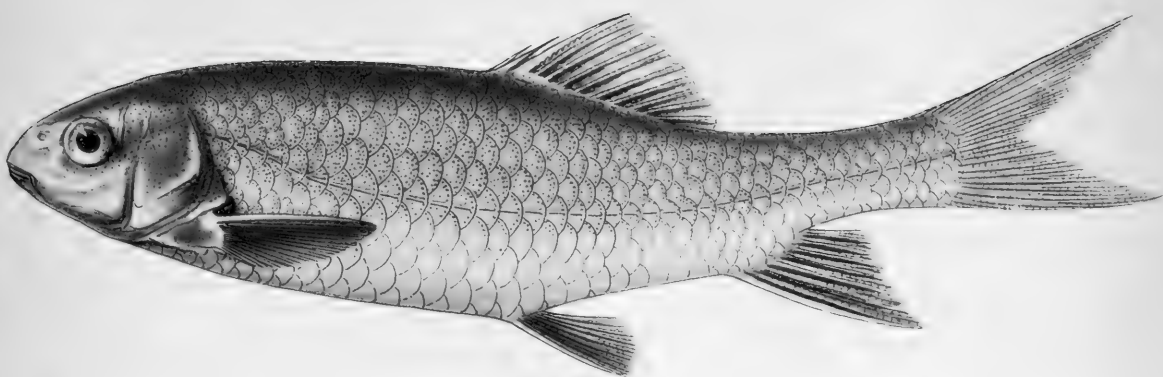
During the prosecution of the Bengal Government's enquiries into the fishery resources of the Sunderbuns two instances of parental care in Siluridæ were met with. On August 22nd shrimp-trawling was tried in the Culputto River (to the eastward of Kaliganj, District of Khulna), and in one of the hauls a specimen of *Arius jatus* was obtained with the young inside the parent's mouth. On examination, this fish, which turned out to be an adult male, had four young fish thus sheltering.

Subsequently when fishing with drift nets off Fraserganj (to the eastward of Saugor Island) near the sea face, an interesting series of the developing eggs of *Osteogeniosus militaris* were obtained. These fish, which were also males, were taken on the night of November 12th, and my attention was first drawn to them owing to their ejecting their eggs when liberated from the meshes of the net. Subsequently three individuals were obtained with the eggs *in situ*. These eggs, which are of the size of marbles, showed a series from the first stages of development to those in which the young is well marked off from the yolk. A series has been mounted for exhibition in the public galleries of the Museum.

¹ For an account of the growth of the intraovarian ova and the appearance of the spent ovary in Teleostei see J. T. Cunningham, "On the Histology of the Ovary and of the Ovarian Ova in certain Marine Fishes," *Quart. Journ. Mic. Science*, vol. xl, 1897-98, pp. 101-163, pls. 2-4.

EXPLANATION OF PLATE VI.

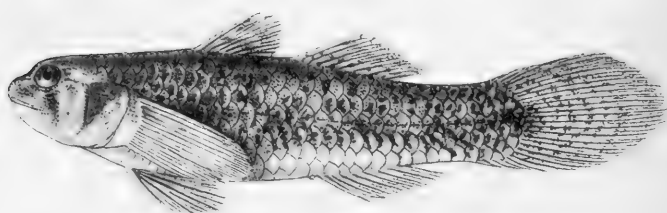
- FIG. 1.—*Scaphiodon baluchiorum*, sp. nov., $\times 2$.
,, 2.—*Gobius chilensis*, sp. nov., $\times 2$.
,, 3.—*Cyprinodon blanfordii*, sp. nov., $\times 2$.
,, 4.— „ *persicus*, „ $\times 2$.
,, 5.— „ *pluristriatus*, sp. nov., $\times 2$.
,, 6.—*Glyptosternum saisii*, sp. nov., nat. size.
,, 7.—*Haplochilus melanostigma*, ♀, with eggs. 7a. Egg enlarged 16 times.



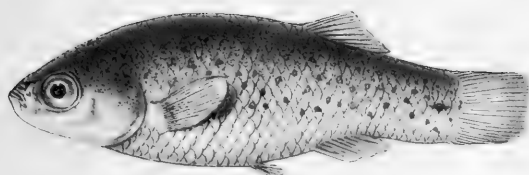
1 x 2



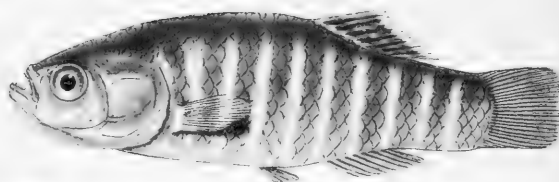
1a x 3



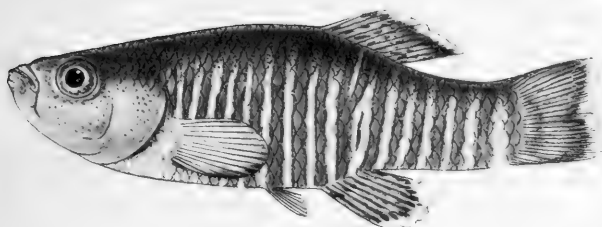
2 x 2



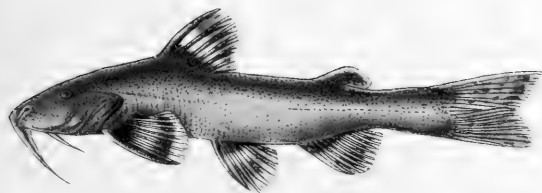
3 x 2



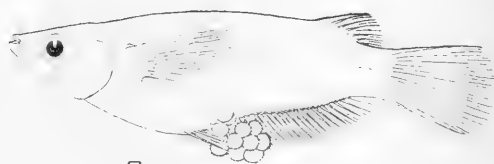
4 x 2



5 x 2



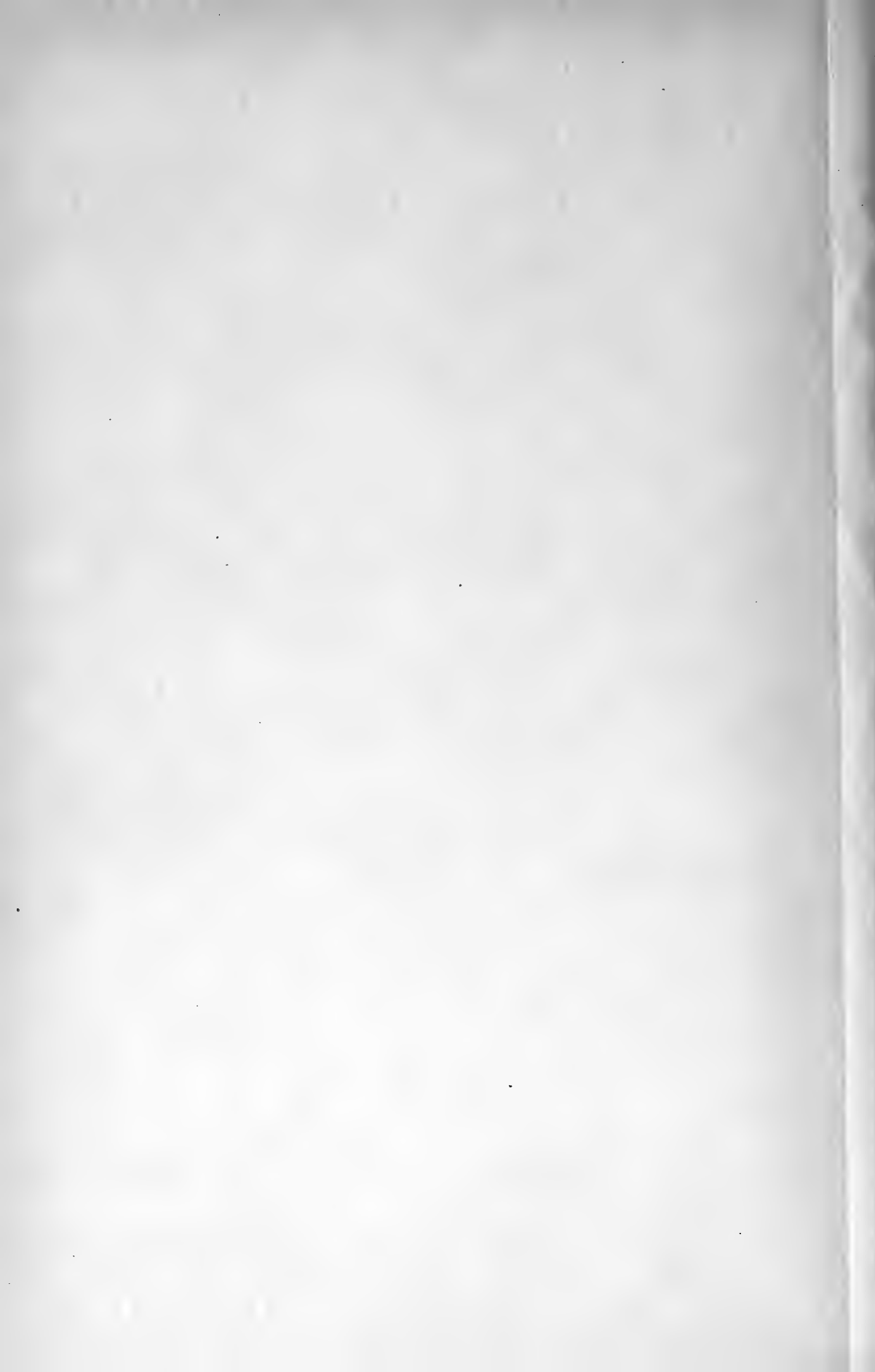
6 x 1



7 x 2



7a x 16



XIII. A NEW GENUS OF PSYCHODID DIPTERA FROM THE HIMALAYAS AND TRAVANCORE.

By N. ANNANDALE, D.Sc., F.A.S.B., Superintendent, Indian Museum.

The genus described below is represented in the collection of the Indian Museum by specimens of two species. One of these species I attributed in a former paper to the fossil genus *Diplonema*, which it resembles as regards the structure of the antennæ and the male genitalia. The venation of the wings is, however, so distinct that it seems necessary to recognize it as representing a new genus, which I have named *Brunettia* in honour of Mr. E. Brunetti, who has done so much to increase our knowledge of the Indian Diptera.

BRUNETTIA, gen. nov.

Diplonema, Annandale (nec Loew), *Rec. Ind. Mus.*, vol. iv, p. 39 (1910).

Heavy moth-like Psychodidæ with broad, thickly-scaled wings, which are held in a horizontal position during repose; second longitudinal vein with three branches, which originate close together near the base of the wing; fourth longitudinal vein with two forks. Mouth parts not forming a proboscis; palpi long, with 4 joints. Antennæ with 15 joints, of which two form the scape; each of the first 12 joints of the flagellum bearing a couple of stout S-shaped chætæ as well as fine hairs. Eyes strongly emarginate. Male genitalia of complicated structure; the inferior appendages bearing numerous racket-shaped spinules; a chitinous intromittent organ present.

Habitat. Darjiling district (E. Himalayas) and Travancore (S. India).

Brunettia differs from *Diplonema*, Loew,¹ not only in its much broader and heavier wings but also in having three branches instead of two to the second longitudinal vein. The palpi also appear to be longer. In respect to venation the wing is to some extent intermediate between that of the Phlebotominæ and that of the Psychodinæ. The lowest branch of the second longitudinal vein is, however, less distinct from the other two than is the case in the genera of the latter family. The male genitalia, moreover,

¹ "Zu der öffentlichen Prüfung der Schüler des Königlichen Friedrich-Wilhelms-Gymnasium zu Posen," *Dipt. Beitr.*, i, 7 (1845).

agree in their complexity with those of the Phlebotominae, and the female genitalia in the absence of the horny ovipositor. *Brunettia* may therefore be placed provisionally in the Phlebotominae.

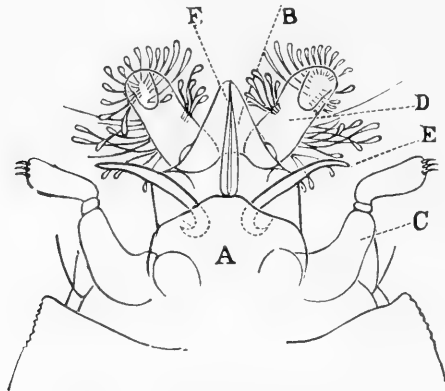
Brunettia superstes (Annandale).

Diplonema superstes, Annandale, *Journ. Asiat. Soc. Bengal*, vol. iv, p. 353 (1908).

♂, ♀. Total length 3 mm.; expanse of wings 8 mm.

Colour sooty black with a strong white refulgence; the first joint of each tarsus partly white, the extent of the white portion varying with the incidence of light.

Antenna with 15 joints; the basal joint cylindrical, the second almost discoidal, these two (the scape) covered with scales; each joint of the flagellum except the last bearing, in addition to a broad basal band of hairs, a long, stout S-shaped chaeta on



Male genitalia of *Brunettia superstes*, from above.

either side; joints of the flagellum spindle-shaped, the distal end of each smooth, devoid of hairs; the last joint bearing hairs only, produced at the tip into a minute, cylindrical, blunt process covered with exceedingly fine pubescence. Palpi 4-jointed; the first joint short, the others longer, subequal; the whole organ covered with flattened hairs, which gradually take the form of scales towards the base of the second joint.

Wings broadly heart-shaped; the convexity of the anterior margin pronounced and irregular; the length to the greatest breadth as 4 to 3; the alula large, elongate, bearing a dense tuft of long hair; the disk covered with overlapping, spatulate scales, which are narrower near the margins than at the centre and base; the veins clothed with a double row of hairs; the marginal fringes long on both margins; a tuft of very long hairs at the posterior basal angle. Subcostal vein practically obsolescent; base of first

longitudinal vein approximating to the stem of the second, the two branches of which arise close together, the second fork being practically opposite the anterior fork of the fourth longitudinal vein; the bases of the second and third and of the fifth and sixth longitudinal veins united; the third vein reaching the margin at a point posterior to the tip of the wing; the fourth nearly straight; the sixth almost as long as the fifth.

Abdomen covered with bristling hairs; thorax covered with similar hairs mixed with scales; front bearing a dense tuft of semi-erect scales.

The male genitalia can now be described in detail, for it has been possible to examine specimens preserved in spirit: to give a satisfactory account of their structure from dried specimens is very difficult. The arrangement of the appendages, etc., is clearly shown in the text figure, which is drawn from a specimen mounted in canada balsam. A represents the supergenital plate (last abdominal tergite), which is thin and membranous, transverse, subtriangular, with the apex slightly emarginate. At either side it becomes chitinized and bending downwards and inwards gives rise to a very stout chæta (E), which bends outwards and slightly downwards. This structure does not appear to be homologous with any in the genitalia of *Phlebotomus*, *Psychoda* or *Pericoma*. On either side, at a lower level, however, there is an appendage (C) evidently homologous with the superior appendage of these genera. It consists of two joints the proximal of which is stout in form and somewhat conical, while the distal joint is flattened and membranous, its sides being sinuous and its tip truncate or very broadly rounded. There are three or four short sensory hairs at the tip, but otherwise the appendage is naked; its integument is thin. The subgenital plate (B) projects as a narrow triangle; its integument is rather thick and bears a minute pubescence. The inferior appendages (D) are borne at the base of the subgenital plate. In the dried specimen they appear to be short and rounded, but they are actually elongate and pointed, with the tips curved upwards and forwards. They bear numerous long hairs and spatulate spinules, each of which (fig. 11, pl. xii) has a fringe of minute spines round its flattened extremity. These spines are all turned inwards towards one surface of the spinule. The intromittent organ (F) consists, as in *Phlebotomus*, of a pair of narrow flattened chitinous valves closely pressed together, the fissure between them being vertical, with a pair of delicate chitinous filaments that can be thrust out between them. The form of the organ in this species is narrowly conical.

The original specimens were taken at an altitude of about 5,000 feet at Kurseong during the "rains" (July) on a window-pane and on the upper surface of a fern-frond. They rested with the wings spread out quite flat. I have recently (June, 1910) taken other specimens at the same place. They were running erratically on the leaves of *Caladium* in dense jungle at dusk.

Brunettia travancorica, sp. nov.

♀. Total length 1.5 mm.; expanse of wings 4 mm.

Colour jet-black with a slight metallic sheen, which is most conspicuous on the lower surface of the wings; nine small white spots at the edge of the wings, each consisting of a tuft of white hair-like scales and situated at the tip of a vein; first tarsal joints white; a tuft of long white hairs on each side of the mesonotum just in front of the wings; some of the hairs on the abdomen grey or white in a reflected light.

The verticels of hairs surrounding the antennæ rather less compact than in *B. superstes* and the S-shaped chætæ more slender.

Wings heart-shaped, the maximum breadth being rather more than $\frac{5}{8}$ of the length; the convexity of the anterior margin much less pronounced and more regular than in *B. superstes*; scales little different from those of the wing of *B. superstes*; a very long marginal fringe on the posterior border only; anterior fork of second longitudinal vein distinctly nearer the base of the wing than that of the fourth longitudinal vein; third longitudinal vein reaching the tip of the wing.

Habitat. Base of Western Ghats, Travancore, S. India: a single female taken by myself in November, 1908.

Lack of material makes it impossible to give a fuller description of *B. travancorica*, which may be distinguished from *B. superstes* at a glance by its smaller size and by the white spots on its wing. It will be noted that the two species differ from one another in the character that distinguishes *Psychoda* from *Pericoma*, namely, the position of the apex of the third longitudinal vein. I think, however, that they must be regarded as congeneric.

ADDENDUM—

A third species of *Brunettia* has recently been taken by Mr. E. E. Green and Mr. F. H. Gravely at Peradeniya in Ceylon. *Psychoda atrisquamis*, Brunetti, from Calcutta also belongs to this genus.—N. A., 24-viii-10.

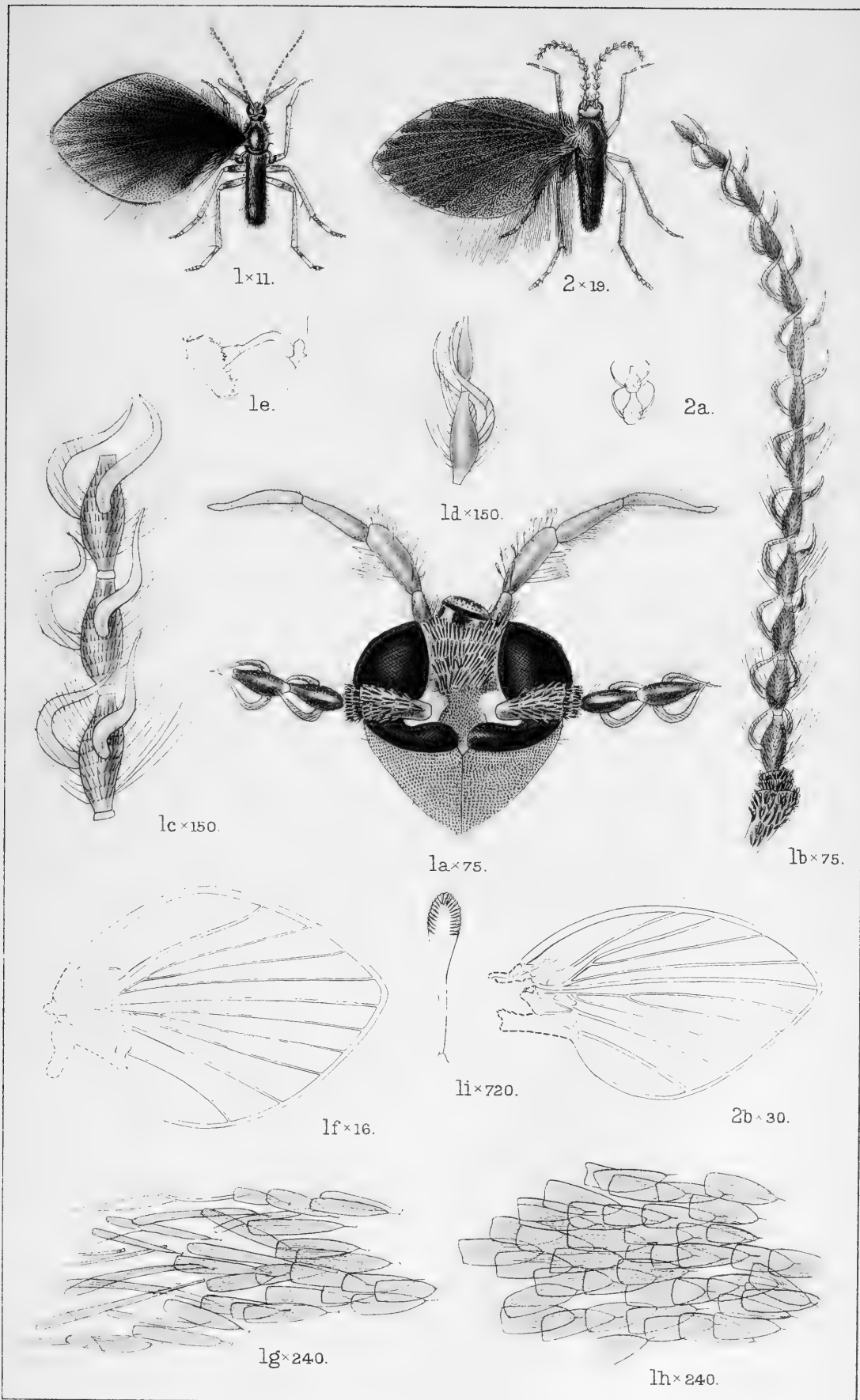
EXPLANATION OF PLATE XII.

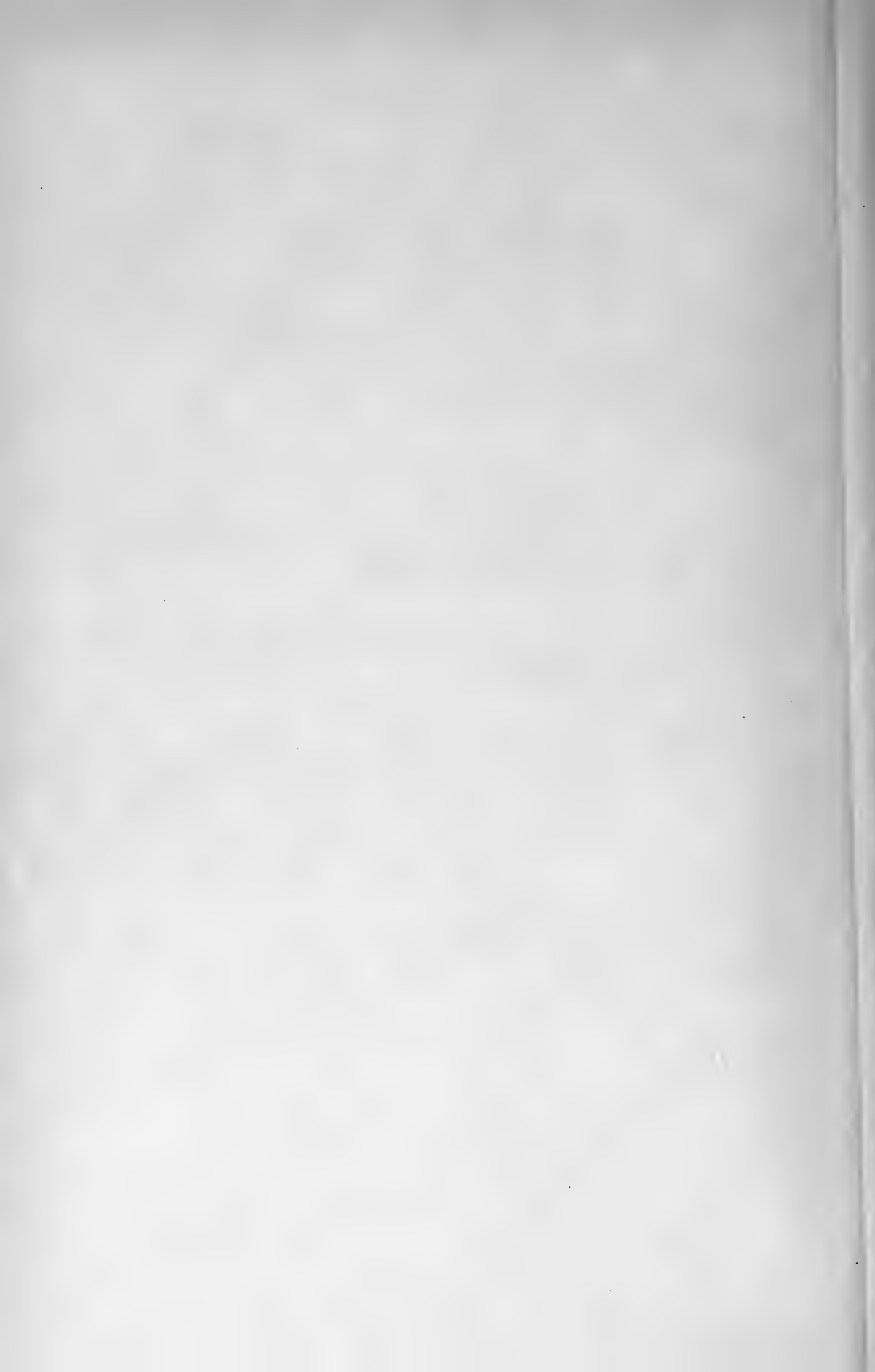
Brunettia superstes and *B. travancorica*.

FIG. 1.—*Brunettia superstes* (♀ type), × 11.

- „ 1a.—Head of *B. superstes* as seen from above, × 75. The posterior part of the head has been denuded of scales but the pits from which they arise are shown. Only the first four joints of the antennæ are represented.
- „ 1b, 1c, 1d.—Antenna of *B. superstes* (♂): 1b = whole antenna, × 75; 1c = first three joints of the flagellum, × 150; 1d = two distal joints, × 150.
- „ 1e.—Halter of *B. superstes* (magnified).
- „ 1f.—Venation of *B. superstes*, × 16.
- „ 1g, 1h.—Scales on wing of *B. superstes*, × 240: fig. 1h represents scales from the centre of the wing; fig. 1g scales from near the margin, illustrating the transition between hairs and scales.
- „ 1i.—Spinule from inferior appendage of male genitalia of *B. superstes*, × 720.
- „ 2.—*Brunettia travancorica* (♀ type), × 19. (The palpi of the specimen are concealed.)
- „ 2a.—First two joints of flagellum of antenna of *B. travancorica* (♀) (enlarged).
- „ 2b.—Venation of *B. travancorica*, × 30.

With the exception of figs. 1, 1e, 2 and 2a, all the figures are drawn from preparations mounted in canada balsam.





XIV. THE INDIAN BARNACLES OF THE SUBGENUS *SMILIUM*, WITH REMARKS ON THE CLASSIFICATION OF THE GENUS *SCALPELLUM*.

By N. ANNANDALE, D.Sc., F.A.S.B., Superintendent, Indian
Museum.

A full account of the Indian representatives of the family Pollicipedidæ must be deferred until opportunities of investigating the littoral fauna of the coasts of India have occurred, for at present our knowledge of this fauna is meagre as compared with that of the fauna of the deeper parts of the Bay of Bengal and the Arabian Sea. In the meanwhile the species of the genus *Scalpellum* may be discussed with some degree of confidence, because, with one exception, they are only found, in Indian seas, at depths greater than 100 fathoms, and because it is now some years since any species not previously represented in the collection of the Indian Museum was obtained by the "Investigator." The present paper, so far as individual species are concerned, deals only with the forms that in my opinion should be placed in the subgenus *Smilium*, but the facts that must be taken into consideration in discussing the subdivision of the genus as a whole are treated in some detail.

DWARF MALES IN *SCALPELLUM*.

Perhaps the most remarkable fact about the genus *Scalpellum* is that its species possess dwarfed and otherwise degenerate males, which live as parasites or rather semi-parasites on the capitulum of the much larger female or hermaphrodite. Probably these males occur in the case of all species of the genus, but they are not always to be found and may, perhaps, only be produced at certain seasons or in certain generations. It is curious that they are invariably absent in the closely allied genus, *Pollicipes*. I do not propose to deal with the minute structure of the dwarf males in either of the genera (*Scalpellum* and *Ibla*) in which they occur, for my friend Captain F. H. Stewart is doing so in the case of several species in a much more detailed manner than I could have hoped to do; but I may point out certain characters in the males that are of systematic importance.

As will be seen (p. 150), two subgenera of *Scalpellum* are recognized in this paper, their recognition depending to a considerable extent on the structure of the male. In the more primitive subgenus (*Smilium*) the larger individuals appear to be invariably

hermaphrodite, that is to say to have the organs of both sexes well developed and functional. The males attached to them resemble young hermaphrodites, so far as external appearance goes, in a more or less accurate manner. As a rule they have the capitulum and the peduncle distinctly separated, and bear calcified valves on the former, the peduncle being devoid of calcareous plates. The capitulum, however, never bears more than six valves (*viz.*, a pair of terga, a pair of scuta, a carina and a rostrum), and even these may be occasionally absent. The external anatomy

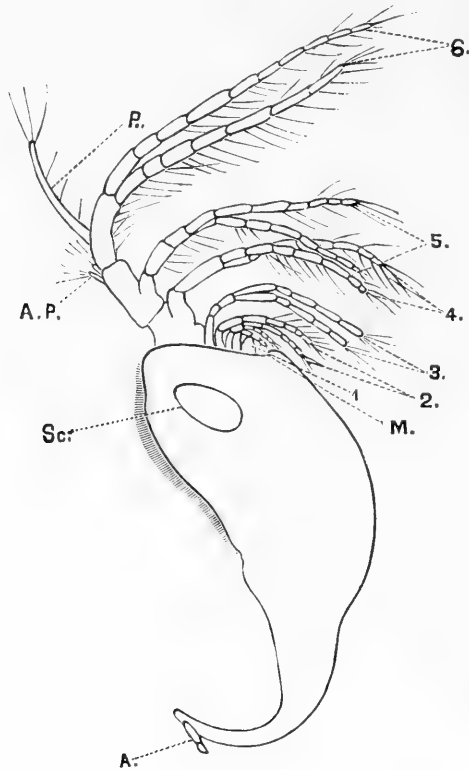


FIG. 1.—*S. bengalense*, male, \times ca. 52: A. = antennæ; A.P. = anal appendages; M. = mouth parts; P. = penis; Sc. = scutum; 1–6 = cirri.

of the body of the male closely resembles that of the young hermaphrodite, differing from that of the adult mainly in the following characters:—(1) the cirri are shorter and less distinctly curved, with the bristles and hairs fewer and exhibiting less differentiation; (2) the mouth parts are more primitive, the labrum being relatively smaller, the teeth of mandible less distinctly separated and often fewer, the bristles on the maxillæ more alike. If the maxilla is notched, this character is less evident in the male than in the hermaphrodite. The male has a well-developed penis,

which often, if not always, differs in shape from that of the hermaphrodite. The alimentary canal is furnished with both a mouth and an anus, and is certainly functional. These characters are better seen in the male of *S. bengalense* than in that of any other species with which I am acquainted, because the body of the male of this species, owing to the peculiar shape of the capitulum, can apparently be thrust out of the capitulum further than is usually the case without interfering with the relations of the different parts. An outline drawing of this form is therefore reproduced in text fig. 1.

In one respect, however, the male of *S. bengalense* differs considerably from that of allied forms, namely, in the degeneracy or absence of the capitular valves, never more than four of which (two terga and two scuta) are present. In more typical species, such as *S. squamuliferum*, the shape and relative positions of the

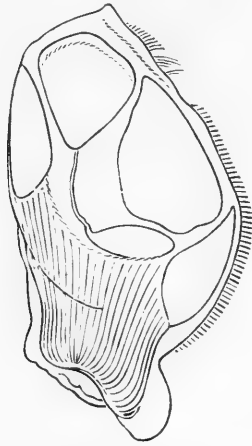


FIG. 2.—*S. squamuliferum*, male, $\times 52$.

valves appear to be very constant and to afford sound diagnostic characters. The external shape of the capitulum and peduncle is also characteristic.

In the less primitive species of the genus comprised in the subgenus *Scalpellum*, the male is far more degenerate. In external shape it is usually ovoid, with no trace of a peduncle. There is rarely any trace of valves, but the whole surface is covered with minute hairs or spines as in the males of *Smilium*. At or near the end opposite to that by which the animal is attached to the capitulum of the female or the hermaphrodite—for in this subgenus the larger individuals appear to be in the case of some species exclusively female—there is an aperture, which is usually circular in outline. From this aperture the generative products are given out and, at any rate in some cases, the tips of the cirri can be protruded. The cirri, however, are much more degenerate

than is the case in the more primitive species. The mouth parts and anal appendages have completely disappeared and even the penis is absent; the alimentary canal is a mere rudiment, without mouth or anus.

Such males are of course incapable of feeding, whereas those of *Smilium* apparently nourish themselves in the manner characteristic of the Cirripedia, that is to say by wafting minute living organisms to their mouth by means of the cirri and then either masticating them or swallowing them whole.

Specific characters are less strongly marked in the case of the more degenerate males than they are in that of the males of *Smilium*, but the nature of the armature is often characteristic, and certain species (e.g., *S. velutinum*) could almost be distinguished by an examination of their males alone, on account of peculiarities in the spines with which the males are invested.

The exact shape of the more degenerate males is, however, a dangerous character on which to lay great stress in classification or specific diagnosis, for it is very liable to be distorted by pressure or by the methods of preservation commonly adopted.

INDIVIDUAL VARIATION IN *SCALPELLUM* AS REGARDS THE DEVELOPMENT OF VALVES.

A fact that has caused some confusion as regards the taxonomy of *Scalpellum* has recently been brought to light by the researches of Hoek and Pilsbry; I mean the fact that in certain species certain hermaphrodites and females have the capitular valves incompletely developed, so that the valves appear as mere skeletons. Such individuals may conveniently be called "incomplete," while more normal individuals may be called "complete." Incompleteness of the valves is usually accompanied by a thickening of the membrane in which they are embedded and consists mainly in an excavation of one or more margins of the larger paired valves and of a reduction in the size of the latera and carina.

Just as in *Dichelaspis* it is often possible to trace the outlines of the fine primitive valves of the Lepadidæ on the membrane of the capitulum even in species in which the valves themselves have almost disappeared as calcified plates, so in incomplete forms of *Scalpellum* the outlines of twelve or more large valves can be seen, with the calcified plates occupying only part of their area. The nature of the reduction, however, resembles that seen in *Conchoderma* rather than that found in *Dichelaspis*. It is perhaps noteworthy that the reduction of the valves in the dwarf males of *Scalpellum* is again of a different nature, an actual reduction in number taking place, and that the valves in these degenerate individuals differ from those found in typical Lepadidæ in including a rostrum, a valve that is never found in that family. The six valves of the dwarf males of *Smilium* apparently represent the six essential valves of the genus *Scalpellum*, for there is a stage

in the development of the females or hermaphrodites of many species in which these six valves are at any rate very much more conspicuous than any others, if they are not actually the only valves represented. Incompleteness, however, is much more common in the subgenus *Scalpellum*, if it is not actually confined to that subgenus, for species like *Scalpellum* (*Smilium*) *scorpio*, in which the valves are embedded in very thick membrane, do not exhibit incompleteness in the sense in which I have defined the term.

In the young hermaphrodites or females of those species of *Scalpellum* in which incompleteness occurs, at the stage at which all the valves have already made their appearance, the valves are practically normal, and it is only as maturity approaches that their margins become strongly excavated.

As regards variation in the development of the valves one other point may be noted, *viz.*, the rudimentary character of the subcarina and the rostrum in some otherwise normal individuals of species in which they are habitually present. These two valves are rightly considered to be of great importance in the taxonomy of the genus, but it must be noted that even in some species of *Smilium* (e.g., *S. squamuliferum*, otherwise a very constant species) the subcarina is often very minute and still more often completely concealed beneath the membrane. In some species of the subgenus *Scalpellum*, on the other hand, the rostrum, which is always small, may be present or absent, and even the subcarina, which is normally absent in this subgenus, occurs as a minute rudiment in some individuals of *S. laccadivicum*, of which my *S. subflavum* is evidently no more than a "complete" variety.

SUBDIVISION OF THE GENUS *SCALPELLUM*.

Considerable difference of opinion has been held at different times, and, indeed, is still held, by different authorities as regards the subdivision of the genus *Scalpellum* (*sensu Darwinio*). Darwin's great work must be taken as the foundation of all scientific study of the Cirripedia, but it must be remembered that he was only acquainted with a very small proportion of the species of *Scalpellum* now known, and that even as regards the few species he had examined he did not express a dogmatic opinion. Before he wrote his Monograph (1851) Gray and other authors had already described several genera wholly or in part synonymous with the forms he called *Scalpellum*. Pilsbry¹ has recently (1908) revived two of these genera, namely, *Calantica* and *Smilium*, and has also raised several other groups in the genus to generic or subgeneric rank, basing his conclusions partly on the external form of the dwarf male and partly on the position or presence of certain valves in the female or hermaphrodite. Hoek and Gruvel, on the other hand,

¹ "On the classification of Scalpelliform Barnacles," *Proc. Acad. Nat. Sci. Philadelphia*, 1908, p. 104.

while differing as regards details of classification, agree in recognizing only the genus *Scalpellum*, which they subdivide in different ways. Gruvel's classification (1905) was, indeed, based on that set forth by Hoek in the "Challenger" Reports (1883); but the latter author has recently published a new one in his account of the Cirripedia of the "Siboga" (1907).

Taking into consideration the great difference in external form between the males of such closely allied forms as *Scalpellum squamuliferum* and *S. bengalense*, and the variation displayed by the valves in certain species, notably *S. squamuliferum* and *S. laccadivicum*, I find it possible to recognize only two groups of species that can be called subgenera. It is impossible to regard them as distinct genera, because no one character of importance can be stated to be constant in either of them, although the sum of the characters of each differs from that of the characters of the other. These two groups may be called *Smilium* and *Scalpellum*. The former is undoubtedly the more primitive and includes several species that come very close to *Pollicipes*, while the latter consists of forms that have undergone a considerably greater amount of specialization. The two subgenera may be defined as follows:—

SMILIUM, Gray.

Rostrum and subcarina as a rule well developed in the hermaphrodite, but the subcarina sometimes absent; anal appendages usually with one joint, sometimes absent. Dwarf males with well-developed capitulum, cirri, mouth parts and alimentary canal.

TYPE *Smilium peronii*, Gray.

SCALPELLUM, Leach.

Subcarina absent or represented by a mere rudiment; rostrum often absent, never large or prominent; anal appendages as a rule with several or many joints. Dwarf males with the appendages and alimentary canal degenerate and the capitulum not distinct from the peduncle.

TYPE *Scalpellum vulgare*, Leach (= *Lepas scalpellum*, Linné).

Both these subgenera are represented in Indian seas, *Smilium* by three species and *Scalpellum* by at least twelve.

Subgenus SMILIUM.

Key to the Indian species of the subgenus.

- I. Capitulum of hermaphrodite about half as broad as long.
 - A. Peduncular plates in the form of rods set obliquely in the membrane and forming complete circles round the peduncle .. *S. squamuliferum*.

- B. Peduncular plates in the form of flat, transversely oval discs on the surface of the membrane, never completely surrounding the peduncle *S. bengalense*.
- II. Length of capitulum of hermaphrodite much more than twice the breadth. Peduncular plates in the form of imbricating, upwardly directed scales *S. acutum*.

Scalpellum (Smilium) squamuliferum. Weltner.

S. squamuliferum, Weltner, *Sitz.-Ber. naturf. Freunde*, 1894, p. 80, figs.; Annandale, *Illustr. Zool. "Investigator,"* Crust. (Entom.), pl. ii, fig. 4 (1907), and pl. iii, figs. 4—6 (1908).

CAPITULUM compressed, irregularly ovoid, the carinal margin being more strongly arched than the occludent, which, except for the projecting rostrum, is nearly straight and slopes outwards from above. *Valves* 15, moderately stout, white, imbricate, feebly striated vertically, with the lines of growth well marked, covered by a thin but opaque brownish, minutely hairy membrane, the tips projecting upwards. *Carina* simply and not very strongly arched; its dorsum convex; its sides concave (especially above); with strong outer and inner ridges; the umbo apical, situated well above the centre of the terga. *Subcarina* triangular, not very prominent, variable in size, often small and as a rule entirely concealed beneath the membrane. *Rostrum* large, narrowly triangular, curved and prominent, strongly ridged in front. *Terga* narrowly rhomboidal, pointed above, with the main axis slanting outwards from the carina; the sides forming the upper angle straight, shorter than those forming the lower angle, which are arched. *Scuta* subequal to the terga, which they resemble in shape; their main axis vertical; the upper part of each valve slightly retroverted; the occludent margin longer than any of the other sides. *Upper latera* resembling the scuta but of as a rule about half the size, variable, however, in this respect. *Inframedian*, *carinal* and *scutal latera* triangular, more or less completely concealed beneath the membrane; the inframedian latera much larger than the others.

PEDUNCLE variable in length, covered with complete undulating rings of calcareous plates embedded in thick membrane. These plates take, individually, the form of minute rods embedded more or less obliquely in the membrane; the outer extremity is slightly inflated and bears a small pit. Sometimes they are almost completely concealed in the membrane and the rings they form appear to consist merely of raised ridges on the surface of the peduncle.

CIRRI, etc. *Cirri* delicate, not very long or strongly curved, densely fringed on the anterior margin but with the posterior

bunches of hairs feebly developed, especially on the 4th, 5th and 6th cirri. First cirrus long, slender, tapering, with the two rami nearly equal; both margins densely fringed. *Anal appendages* barely reaching the junction of the rami of the 6th cirrus, with one joint, compressed, bluntly pointed at the tip, which bears an irregular tuft of long slender hairs; the whole surface minutely pilose. *Penis* long, slender, contorted. A pair of delicate *ovigerous lamellæ* depending from the dorsal surface of the abdomen.

MOUTH PARTS. *Labrum* produced and pointed. *Mandible* with 5 teeth; the 1st longer but no broader than the 2nd, the outer margin of which is somewhat irregular at the base; the 4th and 5th close together, forming the inner angle; the 5th notched at the base both externally and internally; the whole structure covered with minute hairs. *Maxilla* with a very broad but shallow excavation, which occupies the greater part of its free margin; none of the bristles very stout or long; the exact outline variable.

<i>Length of capitulum</i>	..	26 mm.
<i>Breadth of capitulum</i>	..	13 "
<i>Length of peduncle</i> ..	..	26—44 "

MALE with the peduncle very short and stout, distinctly separated from the capitulum, which bears six calcified valves. The capitulum pointed above, broad in comparison with its length, minutely hairy. *Tergum* broadly triangular, with the base of the triangle rounded and the apex pointing directly downwards. *Scutum* much larger than the tergum and more narrowly triangular; the apex pointing upwards; the outlines somewhat sinuous. *Carina* triangular, with rounded base, not quite so broad (viewed from behind) as the tergum and only a little longer, not reaching upwards as high as the upper margin of this plate; the base slightly lower than that of the scutum and above the apex of the rostrum. *Rostrum* of about the same length as the tergum, rather broader than the carina and with the base produced to a point. *Cirri* and *penis* well developed; *anal appendages* present; *mouth parts* resembling those of the hermaphrodite in miniature except that the labrum is not produced and the inner teeth of the mandibles are not so distinctly separated.

SYSTEMATIC REMARKS. This species is remarkable on account of the possession by the hermaphrodite of ovigerous appendages, which depend from the dorsal surface of the abdomen in the form of a pair of delicate filaments placed one behind the other (*Illustr. Zool. "Investigator,"* Crust. (Entom.), pl. ii, fig. 4). The male belongs to the type most commonly found in the subgenus.

DISTRIBUTION, etc. *S. squamuliferum* has been taken by the "Investigator" at many stations in the Andaman Sea and off the south of India, while the British Museum possesses a specimen from Singapore. Gruvel's statement that the species occurs in Japan is apparently due to a miscalculation of latitude and longitude (*Mon. Cirrh.*, p. 56).

The bathymetrical distribution is a wide one, ranging from a little over 100 fathoms to nearly 1,900 fathoms.

Specimens are most abundant on the glassy filamentous spicules by means of which sponges of the genus *Hyalonema* are anchored in the mud. They also occur, however, on the stems of Antipatharians and even on shells of living molluscs, e.g., on that of *Xenophora pallida*. The species is markedly gregarious, a fact that may be due to the larvæ undergoing a considerable part of their metamorphosis in the egg.

S. squamuliferum is by far the commonest species of Pedunculate in the deeper parts of the Bay of Bengal, and the specimens in the Indian Museum considerably outnumber those of all the other Indian Pollicipedidæ put together. In fact, the species is one of the few (so far as this family is concerned) of which it is possible to say that a satisfactory series exists in any museum. It is therefore unfortunate that it is one which does not, except in two particulars, exhibit any very marked tendency to variation and is apparently of limited geographical distribution. Two features in which its characters are the least constant are the length of the peduncle and the size of the subcarina. Compared with such species as *S. laccadivicum*, it may be described as a constant species. In the neighbourhood of Singapore and in the Gulf of Siam it is replaced by *S. kampeni*, which, however, is a much less constant species and inhabits comparatively shallow water (30—50 fathoms). But *S. rostratum*, also a form that has not been found at great depths, replaces *S. kampeni* in the eastern parts of the Malay Archipelago; it appears to be a fairly constant species.

Scalpellum (Smilium) bengalense, Annandale.

Scalpellum bengalense, Annandale, *Ann. Mag. Nat. Hist.* (7), vol. xvii, p. 395 (1906), and *Illustr. Zool. "Investigator,"* Crust. (Entom.), pl. i, fig. 5 (1907) (young form).

Subsequent additions to the collection prove the type specimens of this species to have been immature. The adult hermaphrodite resembles *S. squamuliferum* very closely both as regards external structure and as regards anatomy, but may be recognized by the following characters:—

- (1) The membrane covering the valves of the capitulum is transparent and of a yellowish colour.
- (2) The peduncular plates take the form, viewed from without, of small, transversely oval, flat bodies, and never surround the peduncle in complete rings or form ridges on its surface.
- (3) There are no ovigerous lamellæ.
- (4) The peduncle is never much longer than the capitulum.

The MALE, however, is completely different in external form and may be described as follows:—

Peduncle long and slender, merging gradually into the capitulum in such a way that the whole body has a vase-like shape.

Capitulum entirely without calcified valves, or with a pair of amorphous scuta, or occasionally with minute terga in addition to such scuta. *Cirri* and *anal appendages* well developed, resembling those of the male of *S. squamuliferum*. *Penis* bluntly rounded at the tip, which is armed with several stout hairs.

SYSTEMATIC REMARKS. The great external difference between the males of *S. squamuliferum* and *S. bengalense*—species so closely allied that the hermaphrodites alone might almost have been considered specifically identical—is a remarkable phenomenon and renders it impossible to regard the external form of the male or the structure of its capitular valves a matter of much systematic importance. The absence of ovigerous lamellæ in the hermaphrodite of the one species and their presence in the other is also a noteworthy feature. The structure of the appendages, etc., of the males of the two species, however, as distinct from the external form, is not dissimilar, and the presence of ovigerous lamellæ is a rare character in the genus. The male is variable not only as regards the armature of its capitulum, but also as regards size and the length of the cirri.

DISTRIBUTION, etc. This species has been taken both in the Bay of Bengal and in the Arabian Sea at depths varying from about 70 to over 500 fathoms. On one occasion it was found in considerable numbers on the carapace of crabs (*Encephaloides armstrongi*), while a few individuals have been taken at greater depths attached to the stems of horny corals.

Scalpellum (Smilium) acutum, Hoek.

Scalpellum (Smilium) acutum, Hoek, *Siboga-Exped.*, "Cirripedia Pedunculata," Monogr. xxxia, p. 64, pl. vii, fig. 1 (1907).

Scalpellum longirostrum, Gruvel, *Cirrh. du "Travailleur" et du "Talisman,"* 1902, p. 70.

There is a single small specimen of this species in the collection of the "Investigator," taken at a depth of 490 fathoms off the Andamans. It is attached to the anchor-filaments of a sponge of the genus *Hyalonema* and is probably immature. The species has been so clearly defined and portrayed by Hoek that no further description is needed. I may say, however, that the Indian specimen is almost exactly intermediate between the form originally described by Hoek in the "Challenger" Reports and that subsequently called *Scalpellum longirostrum* by Gruvel, and I have no doubt that the two forms are specifically identical.

S. acutum has a very wide range in the deeper parts of the Indian, Atlantic and Pacific Oceans.

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XV. ON A SUB-SPECIES OF *SCUTIGERELLA*
UNGUICULATA, HANSEN, FOUND
IN CALCUTTA.

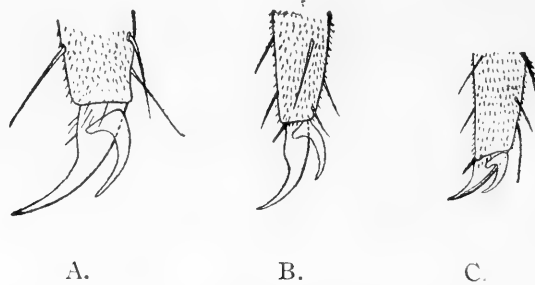
By F. H. GRAVELY, *M.Sc.*, Assistant Superintendent, Indian
Museum.

When hunting for insects under pieces of brick round the Museum tank between March 10 and March 19 of this year (1910), I was fortunate enough to find, close to the water's edge, six specimens of a little white centipede which proved to belong to the interesting genus *Scutigerella*, and to Hansen's Venezuela species *unguiculata* (Hansen, 1904, pp. 34—36, pl. ii, figs. 2a—2k).

The only previous record of any specimen of Symphyla from the Museum compound—or indeed from Bengal—was made by Wood-Mason (1876, p. 175), who “exhibited specimens of a species of *Iapyx* which he had recently found amongst the decaying leaves and fungi at the foot of a bamboo-clump in his own garden at Calcutta,” and mentions as one of the creatures found in association with it “a species of the very remarkable genus *Scolopendrella*.” This record appears to have been made in the month of August when the ground would be much wetter than in March, and as the few remaining bamboo-clumps in the garden are at present much too dry to harbour Symphyla at their base, it seems reasonable to suppose that this so-called “*Scolopendrella*” was in reality the species of *Scutigerella*—this genus was not yet established when Wood-Mason wrote—which now occurs beside the tank. Its present distribution round the tank appears to be extremely limited, however, for it has only been found near the north-east corner, although I have carefully searched for it along all four banks. Since writing the above I have also found a few specimens in the drier neighbourhood of the rubbish-heap near the north-east corner of the tank.

The only named species of Symphyla previously known from India is *Scutigerella subunguiculata*, Imms, which was found at a height of about 9,000 feet up in the Himalayas in the native state of Tehri Garhwal (Imms, 1908). This species, as its name suggests, is very closely allied to *S. unguiculata*, and it is curious to find that the Calcutta specimens depart from the typical form of the latter in the direction of this Himalayan species. Thus, though the two species may be most easily distinguished from each other by the form of the claws of the twelfth foot, in the Calcutta

specimens this foot bears a distinct front seta¹ (see text-figure); the size of the Calcutta specimens (up to 4 mm.) is rather greater than that of any of Hansen's numerous specimens; and the sinus on the posterior margin of the penultimate segment is perhaps hardly as great as in the type. On account of these differences between the Calcutta specimens and the type the former may be regarded as belonging to a local race for which I propose the subspecific name *indica*.



A. Claws of twelfth foot of *S. unguiculata*, Hansen (after Hansen).

B. Claws of twelfth foot of *S. unguiculata (indica)*.

C. Claws of twelfth foot of *S. subunguiculata*, Imms (after Imms).

All drawn to one scale (diam. $\times 330$ about).

The shape of the claw of *S. unguiculata (indica)* may be almost identical with that of *S. unguiculata (s. str.)*; but the distinct front seta is always present.

The known geographical distribution of the two Indian species is—

Scutigereilla unguiculata.

Venezuela: La Moka (type; Hansen, 1904).

India: Calcutta (sub-species *indica*; new record).²

Scutigereilla subunguiculata.

India: near Dhanaulti in Tehri Garhwal (Imms, 1908).

LIST OF PAPERS REFERRED TO.

1876. Wood-Mason, J. "Exhibition of forms of Arthropoda new to India," *Proc. Asiat. Soc. Bengal*, 1876, pp. 174-5.

¹ Hansen says of these claws in *S. unguiculata* (*loc. cit.*, p. 35), "the front seta is rather weak," and in his figure no seta can be clearly distinguished by its size as the front seta. In the Calcutta specimens this seta is quite as distinct as in Imms's figure of the same claws in *S. subunguiculata*.

² This Indian sub-species of *Scutigereilla unguiculata* I have recently found in abundance in Ceylon, both in the Kandy district (1,500 ft. and upwards) and at Pattipola (6,000 ft.). Probably it is widely distributed throughout the island and Mr. Green tells me that he has seen a similar looking little centipede at Pundaloya (4,000—5,000 ft.) and on the top of Namunakuli Hill (6,600 ft.).

1904. Hansen, H. J. "The genera and species of Symphyla,"
Q. J. M. S. (N.S.), xlvii, 1904, pp. 1—101, pl. i—vii.
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252—255, pl. xxxi.
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XVI. THE DISTRIBUTION OF THE ORIENTAL SCOLOPENDRIDÆ.

By F. H. GRAVELY, *M.Sc.*, Assistant Superintendent,
Indian Museum.

WITH A LIST OF THE SPECIMENS IN THE COLLEC- TION OF THE INDIAN MUSEUM, COMPILED FROM DATA SUPPLIED BY DR. KARL KRAEPELIN.

The Scolopendridæ in the Indian Museum have recently been identified by Dr. K. Kraepelin who, however, published no report upon them as they all belonged to well-known species. At the suggestion of Dr. Annandale, therefore, I have prepared a list, drawn up in the order adopted by Dr. Kraepelin in his "Revision der Scolopendriden" (*Mitt. Naturhist. Mus. Hamburg*, xx, 1902, pp. 1—276), with the object of recording their distribution. The page-number given after each genus and species is a reference to the place of its description in this "Revision." The number given in brackets after each locality refers to the number of specimens in the collection. The names of localities enclosed in square brackets are those of places not in the Oriental Region. When that of a *genus* or *species* is similarly enclosed no specimen of it is recorded in Dr. Kraepelin's "Revision" from this Region.

List of the Scolopendridæ in the Collection of the Indian Museum.

Genus *CRYPTOPS*, Leach ; p. 32.

1. *C. sp.* (doubtful).

W. Himalayas : Bhim Tal, 4,500 ft., Kumaon (1).

Genus *OTOSTIGMUS*, Por. ; p. 97.

2. *O. politus*, Karsch ; p. 109.

W. Himalayas¹ : Matiana, c. 8,000 ft., Simla hills (1).

E. Himalayas¹ : Sureil, 5,000 ft., Darjiling district (1).

Assam : Dikrang valley.

¹ The western frontier of Nepal has been taken as the division between E. and W. Himalayas. All records from Nepal, Naini Tal, Almora, etc., have been regarded as Himalayan unless definitely known to belong to the Terai.

3. *O. insularis*, Haase; p. 112.
E. Himalayas: Ghumti, 1,800 ft., Darjiling district (1).
[Found since the collection was returned by Dr. Kraepelin.
I am responsible for this identification.]
4. *O. rugulosus*, Por.; p. 115.
Little Andaman (9).
Lower Burma: Tavoy (5); Mergui Archipelago (3).
[By an oversight the Mergui specimens were not sent to Dr. Kraepelin. They were originally described by Mr. Pocock in the "Mergui Expedition Results," vol. i, pt. 1, 1889 (reprinted from *Journ. Linn. Soc., Zool.*, xxi), as *O. carinatus* var. *insulare*, Haase. Kraepelin raises this variety to specific rank: and he also gives as one of the synonyms of *O. rugulosus*, Por., the *O. carinatus* of Pocock's "Myriopoda of Burma" (*Ann. Mus. Civ. Genova*, xxx, p. 112). A comparison of the Mergui specimens with the *O. rugulosus* identified for us by Dr. Kraepelin reveals no specific difference between the two, whereas the finely grooved polished terga of all these specimens are in striking contrast to the strongly ridged granular terga of our specimen of *O. insularis*. The confusion appears to have arisen from the difficulty, often experienced in examining centipedes, of distinguishing fine grooves on the terga from ridges.]
5. *O. spp.* (doubtful).
W. Himalayas: Murree, Punjab; Theog, Simla hills.
Bombay Presidency: W. Ghats.
Assam: Dikrang valley.
Burma: Upper—Kakhyen hills; Irrawady, 2nd defile.
Lower—Pegu; Tavoy; Upper Tenasserim.
Malay Peninsula: Penang.

Genus RHYSIDA, Wood; p. 139.

6. *R. immarginata* (Por.); p. 143.
W. Himalayas: Naini Tal (1).
E. Himalayas: Nepal—Chitlong, Little Nepal Valley (23);
Pharping (1); Gowchar (1).
Darjiling district—Darjiling (3); Sureil, 5,000 ft. (1); Punkabari (1).
Central Provinces: Nowgong (2).
Bengal: Calcutta (3); Narail, Jessore (2); Ranigunge (5);
Tinpahar (3); Sahibgunge (12).
Assam: Samagooting (12); Dilkoosh, Cachar (1).
Burma: Lower—Rangoon (1); Moulmein (2).
Upper—Pudupyu (3).
Malay Peninsula: Penang (3).
Andamans: Port Blair (1); "Andamans" (6).

7. *R. nuda* (Newp.); p. 144.
Lower Burma: Pegu (2).
8. *R. longipes* (Newp.); p. 148.
United Provinces: Lucknow (2); Chandan-Chowki (1).
Nepal Terai: Dekkat-Bhuli (2).
Bengal: Calcutta (4 + a number of young); Ranigunge (2).
Ceylon: Paradise (1).¹
Lower Burma: Moulmein (3).
Malay Peninsula: Penang (1); Johore (1).
Andamans (3).
[Mauritius (2).]
9. *R. spp.* (doubtful).
E. Himalayas: Kurseong, 5,000 ft., Darjiling district.
[Found since the collection was returned by Dr. Kraepelin.
I am responsible for this identification.]
United Provinces: Bijnor; Kichha
Bombay Presidency: Poona.
Travancore: Maddathorai, at the western base of the W.
Ghats.
Andamans.

Genus *ETHMOSTIGMUS*, Poc.; p. 155.

10. *E. pygomegas* (Kohlr.); p. 158.
E. Himalayas: Darjiling district—Darjiling (3).
Dafra Hills—Harmutti (4); "Dafra" (3);
Burroi, at base of hills (2).
Assam: Garo hills (1); Dikrang valley (7); Silcuri, Cachar
(2); "Cachar" (3); Sibsagar (3).
Burma: Lower—Pegu (1); Pagae, Tavoy (1).
Upper—Nampong, Kakhyen hills (2).
Narcondam Island (1).
Nicobars (1).
11. *E. rubripes* (Brdt.); p. 161.
[Torres Straits: Murray Island (1); N. S. Wales (2).]
12. *E. platycephalus* (Newp.); p. 162.
Lower Burma: Upper Tenasserim (1); hills dividing Burma
and Siam (1).
13. *E. spinosus* (Newp.); p. 163.
Madras Presidency: South Arcot (4).
14. *E. spp.* (doubtful).
Madras Presidency: Chevroy hills.
[Galilee: Mt. Tabor.]

¹ There is a Paradise estate in the Kurunegala district of the N. E. Province; but it is conceivable that the label is an incorrect copy of some contraction of Peradeniya, where the specimen may have been collected by someone working at the laboratories of the Royal Botanic Gardens.

Genus CORMOCEPHALUS, Newp.; p. 184.

15. *C. dentipes*, Poc.; p. 191.
Bengal: Calcutta (1); Paresnath, 4,000—4,500 ft., Chota Nagpur (1).
16. *C. pygmæus*, Poc.; p. 192.
E. Himalayas: Punkabari, Darjiling district (1).
Bengal: Calcutta (2); Chakardharpur, Chota Nagpur (3).
Assam: Silcuri, Cachar (1).
Lower Burma: Tavoy (1).
- [17. *C. rubriceps* (Newp.); p. 198.
New Zealand (1).]
- [18. *C. westwoodi*, Newp.; p. 200.
N. S. Wales (1).]

[Genus TRACHYCORMOCEPHALUS, Kraepelin; p. 218.

19. *T. mirabilis*, Poc.; p. 219.
E. Arabia (1).]

Genus SCOLOPENDRA (L.), Newp.; p. 223.

20. *S. valida*, Luc.; p. 234.
Punjab: Rawal Pindi (1).
Sind: Karachi (2).
Rajputana: Ajmere (2).
Malay Peninsula: Johore (4).
[Persia: Bushire (1).]
- [21. *S. canidens*, Newp.; p. 248.
Galilee: Mt. Tabor (6).]
22. *S. morsitans*, L.; p. 250.
W. Kashmir: Chitral (4); Malakand (1).
W. Terai: Naini Tal district—Joulasal (1); Rausali (1);
Bhura (1).
Almora district—Dugari (3); Melaghat (3).
E. Himalayas: Punkabari (5).
Sind: Cutch (30).
Punjab: Delhi (68); Dera-Ghazi-Khan (3).
Rajputana: Ajmere (3); Jeypore (1).
United Provinces: Hurdwar (48); Bhanwar (1); Buzru-
Kurme, Basti district (1); Allahabad (2; recently
received; my identification).
Bombay Presidency: Poona (2); Mahableshwar (2).
Central Provinces: Chanda (1); Sambalpur (2); Nowgong (1).
Bengal: Calcutta (9); Ranigunge (8); Tinpahar (1); Sing-
bhum (1); Gmatia, Birbhum (1); Rajshahi (1);
Berhampore (4); Bettiah, Champaran (1); Chakar-
dharpur, Chota Nagpur (2).
E. Bengal and Assam: Rajshahi (1); Samagooting (2); Dil-
koosh, N. E. Cachar (8); Sibsagar (1).

- Madras Presidency: Anantigiri, Vizagapatam (7); Waltair (6); Ganjam (2); Ramnad (4); Coimbatore (1); Gopkuda Island, Chilka Lake (1).
- Burma: Lower—Rangoon (1); Moulmein (3); Pegu (2); Tavoy (1); Upper Tenasserim (2).
Upper—Mandalay (2); Pudupyu (1).
- Malay Peninsula: Johore (2); Penang (7); Perak (2).
- Andamans: Port Blair (1); "Andamans" (4).
[Baluchistan: "N. Baluchistan" (10).
Afghanistan (4).
Persia: Bushire (1).
Mauritius (1).]
23. *S. cingulata*, Latr.; p. 254.
Malay Peninsula: Johore (1).
Andamans (1).
[Galilee: Mt. Tabor (2).]
24. *S. subspiniipes*, Leach; p. 256.
Madras Presidency: Cochin (1).
Ceylon: "Paradise"¹ (1).
Lower Burma: Rangoon (1).
Malay Peninsula: Johore (2).
Singapore (1).
Sumatra: Sinkip Island (1).
Java (1).
Hongkong (1): with right anal leg as in var. *dehaani*.
25. *S. subspiniipes* var. *dehaani*, Brdt.; p. 260.
W. Himalayas: Naini Tal (1).
E. Himalayas: Punkabari, Darjiling district (3).
Madras Presidency: Ootacamund, Nilgiris (3); Upper Godavery (1).
Bengal: Calcutta (11); Chinsura (1); Barrackpore (2); Serampore (1); Barrakur (2); "Bengal" (2).
E. Bengal and Assam: Dacca (1); Silcuri, Cachar (2); Dilkoosh, Cachar (3); Jettinga River, N. Cachar hills (5); "Cachar" (1).
Burma: Lower—Moulmein (1); Prome (1); Amherst (3); Upper Tenasserim (12); Ye-bu, Tenasserim (1); Dawna hills (1); Hills dividing Burma and Siam (2); Pegu (3); Kyuk Phyu (1); "Tavoy" (12); Samuading, Tavoy (1); Egaya, Tavoy (1); Mintao, Tavoy (1); Pagae, Tavoy (3); Cheduba Island (3); Mergui Archipelago (8).
Upper—Tsagain (1).
Malay Peninsula: Penang (9); Johore (9).
Sumatra: Deli (1).
Java (1).

¹ See footnote, p. 163.

Andamans: Port Blair (20); "Andamans" (38); Little Andaman (4).

Nicobars (20).

26. *S. subspinipes* var. *hardwickei*, Newp.; p. 262.

Madras Presidency: S. Arcot (1).

Distribution of Oriental Scolopendridæ.

Selecting the records from the Oriental region notified by Dr. Kraepelin in his "Revision" and incorporating with these those of the above list and in a few other papers referred to separately, we have the following distribution recorded for Oriental species:—

Genus CRYPTOPS, Leach.

C. fœæ, Poc.—Burma (Palon).

C. modigliani, Silo—Sumatra.

C. inermipes, Poc.—Christmas Island; ? Burma

C. doriæ, Poc. (= *C. loriæ*, Silv.¹)—Burma (Palon, Shwegoo, Carin Berge, etc.); Sumatra?; Java; New Guinea.

C. spp. (doubtful)—India (W. Himalayas, Madras Presidency 6,000 ft. alt.²).

Genus PARACRYPTOPS, Poc.

P. weberi, Poc.—Flores; Java.

Genus MIMOPS, Kraep.

M. orientalis, Kraep.—China (Prov. Schensi).

Genus OTOCRYPTOPS, Haase.

O. rubiginosus (L. Koch)—China; Japan; N. America (Minnesota, Indiana).

O. melanostomus (Newp.)—From the Philippines over Java, Celebes, Halmaheira, etc., to New Guinea; from Central America (Porto Rico, St. Vincent in the W. Indies) through Venezuela and Brazil to Argentina (Rosario).

var. *celebensis*, Haase—Celebes.

Genus SCOLOCRYPTOPS, Newp.

S. broelemanni, Kraep.—China (Chou-San).

¹ See C. Attems, "Javanische Myriopoden," *Mitt. Naturhist. Mus. Hamb.*, xxiv, 1906 (1907).

² See Kraepelin, *Bull. Mus. Hist. Nat. Paris*, x, 1904, p. 244.

Genus OTOSTIGMUS, Por.

- O. aculeatus*, Haase—Java ; Tonkin.
O. nudus, Poc.—India (Madras Presidency).
O. politus, Karsch—India (W. Himalayas, E. Himalayas, Assam); Burma; Sumatra; China (Tientsin, Tsingtau, Peking); New Guinea; Australia.¹
O. geophilinus, Haase—Java; Timor.
O. ceylonicus, Haase—Ceylon; Burma.
O. scaber, Por.—Burma¹; Malay Peninsula²; Siam; Nicobars; Cochin China¹; China.
O. insularis, Haase—India (E. Himalayas—Bhutan¹ and Darjiling district); Ceylon; Philippines; Seychelles.
O. longicornis (Töm.)—Borneo.
O. asper, Haase—Philippines; Marianne Islands.¹
O. sumatranus, Haase—Sumatra.
O. punctiventer (Töm.)—Sumatra¹; Borneo; Philippines.¹
O. astenus (Kohlr.)—Philippines; Marianne Isles; Caroline Isles; Samoa; Solomon Isles; New Caledonia¹; New Guinea; Australia; Seychelles.
O. rugulosus, Por.—Burma (Tavoy); Siam; Andamans; Seychelles¹; Mauritius.
O. oweni, Poc.—Burma (Mergui Archipelago).
O. spinosus, Por.—Burma (Tenasserim); Java; Borneo; Algeria.
O. feæ, Poc.—Burma.
O. splendens, Poc.—India (Madras Presidency).
O. sucki, Kraep.—Borneo.
O. niasensis, Silv.—Sumatra (Nias Island).
O. morsitans, Poc.—India; Burma; Ceylon.
O. ruficeps, Poc.—India (Madras Presidency).
O. nemorensis, Silv.—Sumatra; Java.
O. orientalis, Por.—India (Bombay Presidency, Madras Presidency 6,000 ft. alt.¹); Seychelles.
O. metallicus, Haase—Ceylon; Sumatra¹; Sangir Island.
O. multidentis, Haase—Sumatra; Java; Borneo¹; Celebes; Mentaway Island.

Genus RHYSIDA, Wood.

- R. immarginata* (Por.)—India (W. and E. Himalayas, Central Provinces, Bengal, Assam, Madras Presidency 6,000 ft. alt.¹); Ceylon²; Burma; Malay Peninsula; Sumatra⁴; Borneo⁴; Andamans; Philippines.
R. nuda (Newp.)—Ceylon; Burma; Siam⁴; Banda; Australia; Paraguay.¹

¹ See Kraepelin, *Bull. Mus. Hist. Nat. Paris*, x, 1904.² See Flower, *Journ. Straits Asiatic Soc.*, No. 36, July, 1901.³ See Pocock, *Journ. Bomb. Nat. Hist. Soc.*, vii, 1892-93, p. 139.⁴ See C. Attems, "Javanische Myriopoden," *Mitt. Naturhist. Mus. Hamb.*, xxiv, 1906 (1907).

- R. carinulata*, Haase—Malay Peninsula¹; Sumatra; Celebes; New Guinea; Thursday Island; Australia.
R. calcarata, Poc.—Siam²; Cambodia.
R. monticola, Poc.—Borneo.
R. longipes (Newp.)—Entire tropical zone of Australia, through Malaysia, Burma, India (United Provinces, Nepal Terai, Bengal) and Ceylon to E. and W. Africa (also Madagascar and Mauritius); Mexico; Central and South America.
R. paucidens, Poc.—India (Madras Presidency); Somaliland.
R. lithoboides (Newp.)—India (Madras Presidency²); China.
R. crassispina, Kraep.—India (Bombay Presidency, Madras Presidency²).
R. petersi (Por.)—India (Bhutan²); Cape Colony.
R. cuprea, Kraep.—India (Bhutan).

Genus ETHMOSTIGMUS, Poc.

- E. pygomegas* (Kohlr.)—N. India (throughout E. Himalayas and Assam); Burma; Narcondam Island; Nicobars.
E. albidus (Töm.)—Singapore.
E. bisulcatus (Töm.)—Siam; Java; Borneo.
E. rubripes (Brdt.)—China; Java; New Guinea; Solomon Isles²; Thursday Island; Australia (Queensland, Sidney, etc.); Tasmania.²
E. platycephalus (Newp.)—India (Madras Presidency); Burma; Java; Molucca; New Guinea; New Britain.
E. spinosus (Newp.)—India (Madras Presidency); Ceylon; Burma (Thagata, Carin Berge).

Genus ANODONTOSTOMA, Töm.

- A. octosulcatus*, Töm.—S. E. Borneo (Matang, Bendjermasin).

Genus ASANDA, Mein.

- A. brevicornis*, Mein.—India (W. Himalayas, Madras Presidency²); Andamans; Socotra; Somaliland²; Arabia.²

Genus CORMOCEPHALUS, Newp.

- C. dentipes*, Poc.—India (Bengal).
C. philippinensis, Kraep.—Philippines.
C. pygmæus, Poc.—India (E. Himalayas, Bombay Presidency, Bengal, Assam, Madras Presidency); Burma.

¹ See Flower, *Journ Straits Asiatic Soc.*, No. 36, July, 1901; *R. carinulata*, Haase, includes *R. rugulosa*, Poc., according to Kraepelin.

² See Kraepelin, *Bull. Mus. Hist. Nat. Paris*, x, 1904.

C. dispar, Por., var. *sarasinorum*, Haase—Ceylon (Newara Eliya).

[*C. dispar*, Por., from S. Africa (Transvaal, Kafferia); Madagascar.]

C. inermipes, Poc.—Ceylon.

Genus *PSILOSCOLOPENDRA*, Kraep.

P. feæ (Poc.)—Burma (Carin Berge).

Genus *SCOLOPENDRA* (L.), Newp.

S. valida, Luc.—India (Punjab, Sind, Rajputana); Malay Peninsula; Canary Isles; Syria; Arabia; Djibuti; Socotra; E. coast of the Persian Gulf.

[var. *simonyi*, Att., Abd el Kuri Island off C. Guardafui.]

S. pinguis, Poc.—Burma (Carin Berge).

S. gracillima, Att.—Java.

S. morsitans, L.—Occurs in all lands of the tropical and temperate zones; centred in the Oriental and African regions.

S. cingulata, Latr.—Malay Peninsula; Andamans; S. Europe; Asia Minor; Syria; N. Africa and in E. Africa as far south as Tanga in German E. Africa (introduced?); Madagascar¹; Brazil.¹

S. subspinipes, Leach—Occurs in all lands of the tropical and temperate zones with the exception of those round the Mediterranean Sea where it is replaced by the allied *S. cingulata*; centre of distribution the Oriental region, where a series of varieties have been evolved.

var. *dehaani*, Brdt.—Chiefly from Sumatra, Java, Malay Peninsula, the whole of Further India (Burma, Siam, Anam) to China and India.

var. *hardwickei*, Newp.—India (Madras Presidency); Ceylon; Further India; Nicobars; Malay Archipelago.

var. *spinossissima*, Kraep.—Philippines.

var. *mutilans*, L. Koch—China; Japan.

var. *multidens*, Newp.—Sumatra¹; Java?; Tonkin¹; China; Japan.

[var. *japonica*, L. Koch, Japan.]

S. indica, Mien.—India (W. Himalayas, Punjab, etc.).

The region regarded as "Oriental" in drawing up the above list extends from the western boundaries of Sind, the Punjab and Kashmir to the eastern shores of Java, Borneo and the Philippines; and all the Chinese species have been included.

The centre of distribution of the Oriental Scolopendridæ seems undoubtedly to be the Malay Archipelago, 33 (excluding the

¹ See Kraepelin, *Bull. Mus. Hist. Nat. Paris*, x, 1904.

species from Singapore which is here regarded as belonging to the Malay Peninsula) out of the known 66 specifically identified forms occurring in these islands. Of these 33 species 14 are known from no other locality, nine of them—*Cryptops modigliani*, *Otostigmus longicornis*, *O. sumatranus*, *O. sucki*, *O. niasensis*, *O. nemorensis*, *Rhysida monticola*, *Anodontostoma octosulcatum*, and *Scolopendra gracillima*—being confined to the Sumatra-Java-Borneo group of islands, one—*Otostigmus punctiventer*—being common to these and to the Philippines, one—*Cormocephalus philippinensis*—being restricted to the Philippines, and three—*Paracryptops weberi*, *Otostigmus geophilinus* and *O. multident*—extending beyond the Oriental region to Flores, Timor and Celebes, respectively. Of the remaining 19 species found in the Oriental section of the Malay Archipelago, the distribution of 2 seems to extend eastwards only—that of *Otostigmus asper* from the Philippine to the Marianne Islands; and that of *Otocryptops melanostomus* from the Philippines and Java to Porto Rico and Argentina, though no records have yet been made between N. Guinea and Venezuela. It is perhaps worth noting here that the only other species of *Otocryptops* included in the above list of Oriental species, *O. rubiginosus*, has a parallel distribution further to the north, extending from China through Japan to N. America where, however, it has apparently only been recorded from the states of Minnesota and Indiana—more than half way across the Continent. There are 10 species found both east and west of the Malay Archipelago. Of these *Scolopendra morsitans* occurs throughout the tropical and temperate zones; *S. subspinipes* shares the same extensive area with the closely allied *S. cingulata* which replaces it entirely round the Mediterranean Sea; and *Rhysida longipes* occurs throughout the tropical zone, being found in India as far north as the Nepal Terai but not in the Himalayas. *Otostigmus politus* is found from China and the Eastern Himalayas to Australia; *Cryptops doriae* from Burma to New Guinea; *Rhysida nuda* from Burma and Ceylon to Australia (also in Paraguay); *Rhysida carinulata* from the Malay Peninsula to Australia; *Ethmostigmus platycephalus* from Eastern India (Madras Presidency) and Burma to New Britain; and *E. rubripes* from China and Java (no intermediate records as yet) to Tasmania and the Solomon Isles. And *Otostigmus astenus*, which extends from the Philippines to New Caledonia and Australia, has in addition been recorded from the Seychelles. Of the 7 remaining species occurring in the Malay Archipelago one—*Rhysida immarginata*—occurs throughout India, Burma and Oriental (not eastern) Malaysia; one—*Otostigmus insularis*—in the Philippines, E. Himalayas, Ceylon and the Seychelles; four—*Otostigmus aculeatus*, *O. spinosus* (found also in Algeria!), *Ethmostigmus bisulcatus* and *Cryptops inermipes*—have only been found in the Burma-Cambodia region on the mainland (there appears to be some doubt, however, as to the occurrence of *Cryptops inermipes* there at all) and in the Sumatra-Java-Borneo group of islands of the Archipelago; and the seventh—*Otostigmus*

metallicus—occurs in Sumatra and Sangir Island and also in Ceylon.

Of the remaining 33 Oriental species 4 are known from the Malay Peninsula, and 13 others from the Burma-Cambodia-Andaman region. Of the 4 Malay species one—*Ethmostigmus albidus*—is only known from Singapore. Another—*Scolopendra cingulata*—also occurs in the Andamans but is otherwise unknown from the Oriental region; it occurs, however, on the one side in Brazil, and on the other in Madagascar, E. Africa and the districts bordering the Mediterranean Sea in Africa, Asia and Europe. *Scolopendra valida* is found in north-west India (excluding the Himalayas), Persia, Syria, Arabia, Socotra and the Canary Islands, and *Otostigmus scaber* occurs in the Nicobars, Burma, Siam and China. Of the 13 additional species found in Burma, etc., one—*Rhysida calcarata*—is known from Cambodia and Siam only, and five—*Cryptops feæ*, *Otostigmus oweni*, *O. feæ*, *Psiloscolopendra feæ* and *Scolopendra pinguis*—from Burma only. *Otostigmus ceylonicus* occurs only in Burma and Ceylon, *O. morsitans* and *Ethmostigmus spinosus* in these two countries and in India. *E. pygomegas* extends from the Nicobars and Burma through Assam and the Eastern Himalayas; *Cormocephalus pygmæus* is probably to be found all over India and in Burma. And there are two species which have a more scattered distribution, *Otostigmus rugulosus* occurring in Siam, Burma and the Andamans, the Seychelles and Mauritius; and *Asanda brevicornis* in the Andamans, Madras Presidency of India, Arabia, Socotra and Somaliland—a distribution allied to that of *Scolopendra valida* described above.

There are 2 species which appear to be peculiar to China—*Mimops orientalis* and *Scolocryptops broelemanni*. The distribution of *Otocryptops rubiginosus* which is confined in the Oriental Region to China has been referred to above. Another 2 species—*Cormocephalus dispar* var. *sarasinorum* and *C. inermipes*—are confined to Ceylon, *C. dispar* (s. str.) being however only found in Madagascar and S. Africa.

The remaining 11 species are all Indian. *Otostigmus nudus*, *O. splendens* and *O. rufriceps* are only known from the Madras Presidency; *Rhysida crassispina* from the Madras and Bombay Presidencies; and *Otostigmus orientalis* from these two districts and the Seychelles. *Cormocephalus dentipes* is recorded only from Bengal, *Rhysida cuprea* from Bhutan and *Scolopendra indica* from the W. Himalayas, Punjab, etc. *Rhysida lithoboides* occurs in India and China, *R. paucidens* in India and Somaliland and *R. petersi* in India and S. Africa.


It would be futile to attempt to draw any far-reaching conclusions from the above records, for it is almost certain that many species will eventually be found in fresh localities as soon as these can be thoroughly examined. A few noteworthy facts may, however, be briefly noted here.

As stated above, the Oriental Scolopendridæ seem to be centred in the Malay Archipelago. Species found in the "Oriental"

portion of this Archipelago (excluding the three which occur in all longitudes) are found to extend eastwards through Polynesia and Central America to Porto Rico and Argentina; southwards to Tasmania; northwards to China; and westwards practically not beyond the boundary of the Oriental region, though one species occurs in Socotra and one, otherwise not known west of Burma, has been found in Algeria. Thus they appear as a whole to have a much wider distribution over the islands to the east than over the mainland to the west.

Again excluding the three most widely distributed species, we find that only two species are common to the Philippines and to the Sumatra-Java-Borneo group, the former having three additional species and a local variety of *Scolopendra subspinipes*, and the latter twenty-seven additional species. Thus these two groups of islands will probably be found to form separate zoogeographical subdivisions of Oriental Malaysia so far as the Scolopendridæ are concerned.

With regard to the mainland it is almost impossible to draw any satisfactory conclusions on account of the scrappy nature of our information. Several forms appear at present to have a very erratic and scattered distribution. Records of the altitude at which specimens were found are particularly scanty and very badly needed. It is not surprising to find that the habitat of several species occurring in the Archipelago extends into Burma. A few of these range through Assam to India and China, and there seems to be a tendency for such species to extend particularly along the Himalayas. As might well be expected, too. Further India and the Indian Peninsula (India Proper) have each several species which are not found in the other. It may be noted moreover that in the Indian Peninsula *Scolopendra subspinipes* (s. str.) and its var. *hardwickei* appear to be confined to the extreme south, var. *dehaani* being the dominant form in the northern parts.



XVII. NOTES ON DECAPODA IN THE INDIAN MUSEUM.

I.—THE SPECIES OF *Gennadas*.

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Indian Museum.

(Plates xiii and xiv.)

Among the vast collection of Decapods which has been made by the 'Investigator' thirteen examples of the genus *Gennadas* occur and, although the majority of these specimens have already been mentioned by Alcock,¹ it has now become necessary to submit them to revision. In 1901, when Alcock wrote, the characters by which the many closely-allied species of this genus were determined had not been fully appreciated and our knowledge of the extra-Atlantic forms was limited almost entirely to the wholly inadequate treatment which Spence Bate accorded them in his 'Challenger' Report.

Recently Bouvier has published a most valuable account² of the Atlantic species in which he draws attention to the importance of several characters which had previously been overlooked and, now that the 'Challenger' collections have been revised on the same lines,³ the determination of the material preserved in the Indian Museum presents a task of no great difficulty.

In the following descriptive notes all the more important characters suggested by Bouvier have been employed. It seems, however, that the Oriental species of the genus form a much more homogeneous group than those found in the Atlantic and, apart from the petasma and thelycum, little can be found which is of real systematic value. Useful indications are afforded by the antennular peduncle, the antennal scale and the second maxilla, but in other respects, such as the proportions of the mandibular palp and the respective lengths of the joints of the first three

¹ Alcock, *Desc. Cat. Ind. deep-sea Macrura*, 1901, p. 45.

² Bouvier, *Rés. Camp. Sci. Monaco*, fasc. xxxiii, 1908, p. 24.

³ Kemp, *Proc. Zool. Soc.*, 1909, p. 718. From the list of species of *Gennadas* given at the end of this paper (p. 728) two Pacific forms, *G. clavicarpus* and *G. pasithea*, are unfortunately omitted. Preliminary descriptions of these two species, which were obtained by the 'Siboga' expedition, have been given by Dr. J. G. de Man (*Notes Leyden Mus.*, xxix, 1907, p. 144). Both are, I believe, distinct from the 'Challenger' species and from those here described, but, until figures of the petasmata and thelyca are published, it is impossible to be quite certain.

pairs of peraeopods, a considerable amount of variation is sometimes to be found.

Three of the species in the collection are regarded as new, an interesting variation in the petasma of *G. scutatus*, Bouvier, is noticed and a fresh description is given of *G. carinatus*, Smith, a remarkable form which combines in one species the characters both of *Gennadas* and of the allied genus *Benthesicymus*.

The number of specimens examined is unfortunately small and this is doubtless due to the fact that the 'Investigator' collections were made almost entirely by means of trawls fishing on the bottom. The species of *Gennadas*, as far as is at present known, are entirely pelagic in habit and their occasional appearance in bottom hauls is explained by the fact that they are sometimes caught while the net is being hauled to the surface.

All the species mentioned in this paper possess podobranchs on the first three pairs of peraeopods and are in consequence members of the genus *Gennadas*, *sensu stricto*.

The measurements given represent the total length, and were taken from the apex of the rostrum to the tip of the telson, with the animal extended as nearly as possible in a straight line.

***Gennadas alcocki*, sp. nov.**

(Plate xiii, figs. 5—8.)

St. 111.—Bay of Bengal, 12° 50' N., 90° 52' E., 1,644 fathoms. One male, 36 mm.

St. 103.—Bay of Bengal, 15° 14' N., 81° 9' E., 1,260 fathoms. One female, about 25 mm.

St. 108.—Off C. Comorin, 7° 4' N., 76° 34' 15" E., 1,043 fathoms. One male, 34 mm.

St. 309.—Near the Andaman Islands, 10° 9' N., 93° 2' 15" E., 765 fathoms. One male, 34 mm.

The rostrum is well elevated above the dorsal carina of the carapace and bears the usual small tubercle behind the dorsal tooth. The antennary and infra-antennary angles are acute and the branchiostegal spine is small but evident. The cervical and post-cervical grooves of the carapace are well marked; dorsally, the distance between them is only about one-fifth of the distance from the post-cervical groove to the hinder margin. The median carina is visible throughout the length of the carapace.

The second joint of the antennular peduncle, measured dorsally, is fully two-thirds the length of the ultimate joint. The antennal scale (fig. 7) is a little more than three times as long as wide; the outer margin is somewhat convex and terminates in a spine which extends beyond the narrow apex of the lamella.

The ultimate joint of the mandibular palp varies in length, but is, in all cases, shorter than the greatest width of the basal joint. In the second maxilla the anterior lobe of the internal

lacinia is slightly broader at the apex than at the base and is a little narrower than the adjacent lobe of the external lacinia. The apex of the endopod is narrow and bears from three to five spines on its external aspect.

In the first maxillipede the third joint of the endopod is oval and very nearly twice the length of the second; the basal joint bears five stiff spines on its inner distal margin.

The carpus of the first pair of peraeopods is shorter than the chela and is only a little more than half the length of the merus. In the second pair the chela is seven-eighths the length of the carpus and the dactylus is equal to, or shorter than, the palm. In the third pair the merus and carpus are of the same length; the chela is half, or a little more than half, the length of the carpus and the dactylus is a trifle shorter than the palm.

The sixth abdominal somite alone is dorsally carinate and all the median tubercles on the abdominal sterna with the exception of the first are blunt and inconspicuous. The apex of the telson is truncate and bears four or five pairs of plumose setae, of which the middle pair is the longest, between the stout marginal spines.

The petasma (figs. 5, 6) bears some resemblance to that of *Genadas parvus*, but, judging by the dissimilarity which exists in regard to the other characters, more especially in the antennal scale and antennular peduncle, it does not seem in close manner. The forms are allied to one another in aspect varies considerably in the distal margin.

I have associated this species with the name of Lieut.-Colonel Alcock who has given a very accurate description of the thelycum (*loc. cit.*, 1901, p. 47, sub "*G. parvus*"). His account, which may be compared with fig. 8, runs as follows:—"The thelycum consists of a horizontal, subtriangular plate or tubercle, placed between the third pair of legs, followed by two transverse bars between the fourth and fifth pairs. The first of these bars is somewhat W-shaped with the posterior notch of the W filled by a tooth in the middle of the anterior border of the second bar."

The specimen which Miss Rathbun¹ has attributed to *Genadas parvus*, remarking that the thelycum agrees exactly with Alcock's description, is certainly quite distinct from the species here described. The true female of Spence Bate's *G. parvus*, which I have recently discovered in a collection made by Dr. J. Stanley Gardiner, is, in respect of the thelycum, wholly different both from the present species and from that figured by Miss Rathbun.

¹ Rathbun, *Bull. U. S. Fish Comm. for 1903, 1906*, p. 907.

Gennadas praecox, sp. nov.

(Plate xiii, figs. 1—4.)

St. 320.—Off C. Comorin, $7^{\circ} 23' N.$, $75^{\circ} 44' E.$, 1,053 fathoms. One male, $32\frac{1}{2}$ mm.

The rostral crest is much the same as in the two preceding species, but the dorsal spine is more slender. The antennary and infra-antennary angles are acute, but rather bluntly rounded at the apex; the branchiostegal spine is minute. The cervical and post-cervical grooves of the carapace are deeply cut; they approach one another very closely in the mid-dorsal line, where the distance between them is scarcely one-sixth the distance from the post-cervical groove to the hinder margin. The mid-dorsal carina runs the whole length of the carapace, but is inconspicuous posteriorly.

The second joint of the antennular peduncle, measured dorsally, is about two-thirds the length of the ultimate segment. The antennal scale (fig. 1) is three and a quarter times as long as broad; it is widest basally and its outer edge, which is nearly straight, terminates in a small spine which falls far short of the narrow apex of the lamellar portion.

The ultimate joint of the mandibular palp is about as long as the greatest width of the penultimate joint. In the second maxilla (fig. 2) the anterior lobe of the internal lacinia is strongly constricted behind and similarly-constricted lacinia is a trifle narrower than the adjacent lacinia the anterior lobe is fully one and a half times the posterior. The third joint of the endopod of the first maxilliped is fully twice the length of the second; the fourth is extremely minute. Two stiff curved spines are situated on the inner distal margin of the joint.

The carpus of the first pair of pereopods is about the same length as the chela and is two-thirds as long as the merus. In the second pair the chela is three-quarters the length of the carpus and the dactylus is shorter than the palm. The carpus of the third pair is about equal in length to the merus; the chela is only a little more than half the length of the carpus and the dactylus is fully as long as the palm.

The median spines on the abdominal sterna are blunt and inconspicuous; the sixth somite alone is dorsally carinate. The telson is squarely truncate at the apex and is furnished with spines and setae as in *G. alcocki*.

The petasma (figs. 2, 3) is most peculiar and utterly unlike that of any species hitherto described. In what appears to be its natural position each of the two halves is roughly triangular in shape and is provided with two long and narrow processes, one on its distal and inferior aspect and one, curved and directed inwards, which arises close to the superior inner margin. In place of the numerous small pleats, which are usually found near the line of connection of the right and left halves, there is, in this instance, a

single large fold involving nearly one-third of the whole plate. When this fold is opened out the structure presents the appearance shown in fig. 3.

***Gennadas sordidus*, sp. nov.**

(Plate xiv, figs. 1—3.)

St. 193.—North of the Laccadive Islands, $15^{\circ} 11' N.$, $72^{\circ} 28' 45'' E.$, 931 fathoms. One male, about 20 mm.

St. 194.—Off the Laccadive Islands, $13^{\circ} 47' N.$, $72^{\circ} 3' 45'' E.$, 891 fathoms. One male, 24 mm.

St. 198.—North-east of Ceylon, $8^{\circ} 55' N.$, $81^{\circ} 17' 30'' E.$, 764 fathoms. One male, $18\frac{1}{2}$ mm.

The rostral crest does not differ appreciably from that of the preceding species. The antennary and infra-antennary angles are acute, the former being bluntly rounded and the latter sharp; the branchiostegal spine is very small. The distance between the cervical and post-cervical grooves, measured dorsally, is less than one-fifth the distance from the post-cervical groove to the hinder margin of the carapace. The mid-dorsal carina is inconspicuous behind the latter groove.

The second joint of the antennular peduncle is very short; measured dorsally, it is less than half the length of the ultimate joint. The antennal scale is widest at the base; it is three times as long as wide and the outer margin terminates in a very small spine which does not extend as far forwards as the lamellar portion.

The ultimate joint of the mandibular palp is shorter than the greatest width of the basal joint. In the second maxilla (fig. 3) the anterior lobe of the internal lacinia is short, not wider at the apex than at the base, and is little, if at all, narrower than the adjacent lobe of the external lacinia. In the latter lacinia the anterior lobe is about one and a half times as broad as the posterior. The endopod is furnished with three curved spines near the narrow apex.

The third joint of the endopod of the first maxillipede is about one and a half times the length of the second and the basal joint bears two or three stiff spines on the inner distal margin.

In the first peraeopods the chela, which is about as long as the carpus, is about two-thirds the length of the merus. The chela of the second pair is two-thirds the length of the carpus and the dactylus is equal to, or a trifle shorter than, the palm. In the third pair the carpus and merus are exactly the same length; the dactylus is as long as the palm, the whole chela being about half the length of the carpus.

The median spines on the abdominal sterna are not prominent; the sixth somite alone is dorsally carinate. The apex of the telson has much the same form as in *G. alcocki*.

The petasma (figs. 1, 2) is a rather complicated structure and is of much the same type as that of *G. parvus*, to which *G. sordidus*

is evidently very closely allied. The most distinctive character which it possesses is the spoon-shaped portion which is directed forwards from the middle of the distal margin of each lobe.

Gennadas scutatus, Bouvier.

(Plate xiii, figs. 9, 10.)

Gennadas scutatus, Bouvier, *Rés. Camp. Sci. Monaco*, xxxiii, 1908, p. 42, pl. viii.

Gennadas scutatus, Kemp, *Proc. Zool. Soc.*, 1909, p. 727, pl. lxxv, fig. 2.

St. 108.—Off C. Comorin, $7^{\circ} 4' N.$, $76^{\circ} 34' 15'' E.$, 1,043 fathoms. One male, about 29 mm.

St. 109.—Off C. Comorin, $7^{\circ} 1' N.$, $78^{\circ} 21' E.$, 738 fathoms. One male, broken.

With the exception of the petasma, these specimens agree closely with the example obtained by the 'Challenger' in the N. Pacific (Kemp, *loc. cit.*). They differ from Bouvier's description and figures in the following particulars:—

The ultimate joint of the mandibular palp is fully as long as the width of the basal joint. In the second maxilla (fig. 9) the anterior lobe of the internal lacinia, though not wider at the apex than at the base, is widely separated from the posterior lobe and is narrower than the adjacent lobe of the external lacinia. The third joint of the endopod of the second maxillipede is a trifle wider than in Bouvier's figure. The chelae of the third pair of peraeopods are longer; in one specimen they are three-fifths the length of the carpus, while in the other they are a trifle shorter, but still considerably more than half the length of the carpus.

The petasmata of the two specimens are as nearly as possible identical and, considering the great uniformity of outline which these structures usually present, show a considerable amount of divergence from the type. The principal points of difference, as will be seen by comparing fig. 10 with Bouvier's text-figure,¹ concern the development of the large median distal lobe. This is truncate and furnished with a small pointed process on the outward side in the type, while in the present specimens it is sharply pointed and the small process is entirely absent.

Gennadas scutatus is now known from the Atlantic (Bouvier), from the Pacific ('Challenger') and from the two localities mentioned above. When more extensive collections have been made, it will be possible to determine whether, in these widely distant localities, there really exist distinct races of this species, differing from one another in the form of the petasma, or whether there is in this respect merely an exceptionally large range of variation.

¹ Bouvier, *Bull. Mus. Océanog, Monaco*, No. 80, 1906, p. 11, fig. 13.

Gennadas bouvieri, Kemp.

Gennadas bouvieri, Kemp, *Proc. Zool. Soc.*, 1909, p. 726, pl. lxxiv, figs. 1—4; pl. lxxv, figs. 6 and 7.

St. 198.—North-east of Ceylon, $8^{\circ} 55' N.$, $81^{\circ} 17' 30'' E.$, 764 fathoms. One female, about 25 mm.

This specimen agrees closely with the description of the type. The only important difference lies in the proportional length of the joints of the third pair of peraeopods, where the merus is only very slightly shorter than the carpus. Except for the fact that no spermatophores are inserted, the thelycum is practically identical with that figured in 1909 (pl. lxxv, fig. 6).

G. bouvieri was found by the 'Challenger' west of Manila and north of New Guinea.

Gennadas carinatus (Smith).

(Plate xiv, figs. 4—9.)

Benthescymus? *carinatus*, Smith, *Rep. U. S. Fish Comm.* for 1882, 1884, p. 396, pl. x, figs. 6 and 7.

Gennadas carinatus, Alcock, *Desc. Cat. Ind. Macrura*, 1901, p. 46.

Gennadas carinatus?, McGilchrist, *Ann. Mag. Nat. Hist.*, March, 1905, p. 236.

St. 128.—Off C. Comorin, $6^{\circ} 58' N.$, $77^{\circ} 26' 50'' E.$, 902 fathoms. One male, 130 mm.

St. 306.—Off Travancore, $9^{\circ} 20' N.$, $75^{\circ} 24' E.$, 930 fathoms. One female, 148 mm.

This large species is of great interest and, although the two specimens in the Indian Museum have already been recorded by Alcock and McGilchrist, a fresh description drawn up on the lines of Bouvier's recent work may be found useful.

I have followed Alcock in placing the species in the genus *Gennadas*, though, in point of fact, it is almost exactly intermediate in character between that genus and *Benthescymus*. In habit, however, the two genera appear to be quite distinct, for *Gennadas*, as far as at present known, is entirely pelagic, whereas *Benthescymus* lives on the bottom. Now in *carinatus* the joints of several of the appendages are greatly flattened and expanded and closely resemble those of the former genus, and this modification, which is doubtless correlated with a free-swimming existence, has induced me to retain the species in its present position.

Alcock has, indeed, suggested that it might be best to regard *Gennadas* as a subgenus of *Benthescymus*, but from a practical point of view this cannot be recommended. It must be remembered that it is only in the present case that any difficulty arises in allocating the species to one or other genus.

Although the two specimens, on which the following account is based, are very macerated, all the appendages are represented with the exception of the last three pairs of peraeopods.

The rostral crest (fig. 4) is elevated well above the dorsal carina of the carapace and differs from that of all other known species of *Gennadas* in having the superior margin, between the apex and the small dorsal tooth, strongly convex. This margin also appears to lack the usual fringe of setae which occurs in the other species. The antennary angle of the carapace is rectangular, but the infra-antennary, as in Bouvier's *Gennadas alicei*, is entirely absent. The branchiostegal spine is prominent. The cervical and post-cervical grooves are rather strongly marked. Dorsally they are widely separate, the distance between them being at least one half the distance from the post-cervical groove to the posterior margin. The mid-dorsal carina extends the whole length of the carapace but is blunt posteriorly.

The eyes are large and appear to have been deeply pigmented in life; the conical process on the dorsal surface of the stalk is quite unusually small.

The second joint of the antennular peduncle is, measured dorsally, fully as long as the ultimate segment and is articulated to it by its entire margin and not merely by the inferior edge as in other species of the genus. The dilated portion at the base of the upper flagellum is as long as the two proximal joints of the peduncle. The antennal scale is unfortunately incomplete in every case. It was evidently little more than twice as long as wide and the very broad apex of the lamella appears to have extended far beyond the spine which forms the termination of the convex outer margin.

The ultimate joint of the mandibular palp (fig. 5) is longer than the greatest width of the basal joint. In the second maxilla (fig. 6) the anterior lobe of the internal lacinia is not wider at the truncate apex than at the base, and is not so broad as the adjacent lobe of the external lacinia. The endopod has almost exactly the same form as in *Benthesicymus* and bears from ten to fourteen curved spines on its external aspect near the apex.

In the first maxillipede (fig. 7) the exopod is provided with a terminal lash as in typical *Benthesicymus* and the third joint of the endopod is about twice the length of the second. The merus of the second maxillipede (fig. 8) is twice as long as wide and its anterior prolongation (the part which extends forward beyond the insertion of the carpus) is less than one-fifth the entire length of the segment. The dactylus is provided with a single apical spine.

In the first pair of peraeopods the carpus, which is about the same length as the chela, is two-thirds the length of the merus. In the second pair the carpus is as long as, or a little shorter than, the merus, the chela is only a trifle more than half the length of the carpus and the dactylus is about as long as the palm.

The rudimentary exopods, mentioned by Smith, are visible only in the case of the female specimen.


The merus of the second maxillipedes and the ischium and merus of the third maxillipedes and first three pairs of peraeopods are greatly expanded as in typical *Gennadas*.

The third, fourth, fifth and sixth abdominal somites are dorsally carinate. The telson is much longer than in other species of *Gennadas*, being only a little shorter than the outer uropod. It bears four pairs of lateral spines in its distal third and is sharply pointed apically.

The petasma (fig. 9) consists of a pair of simple leaves, as in *Benthescymus*.

The thelycum has been well described by McGilchrist in the following words: "Between the bases of the fourth pair of legs a prominent central papilla stands. Towards this papilla a hairy process passes inwards and backwards from the base of each of the third pair of legs and from the base of each of the fourth pair of legs a tongue-shaped process projects inwards and backwards posterior to the papilla. The papilla thus stands in the centre between the tips of these four processes."

Apart from the type, only the two specimens mentioned above are known. Smith's example, which was found off the east coast of the United States, $39^{\circ} 44' 30''$ N., $71^{\circ} 4'$ W., in 1,022 fathoms, measures only 74 mm. in length and is thus only about half the size of those from the Arabian Sea.



EXPLANATION OF PLATE XIII.

Gennadas praecox, sp. nov.

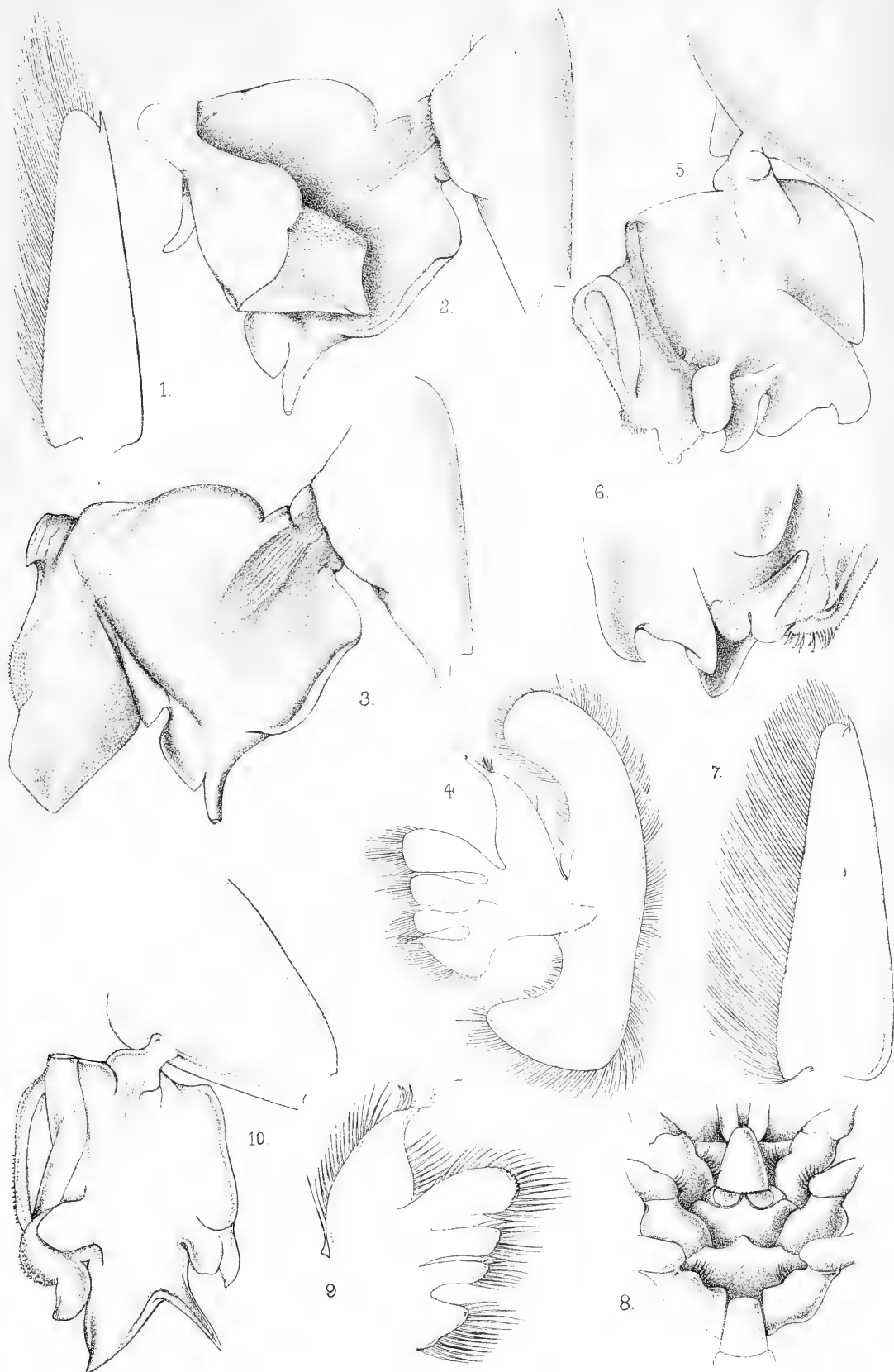
- FIG. 1.—Antennal scale, $\times 8$.
,, 2.—Right-half of the petasma, folded naturally, $\times 16$.
,, 3.—The same unfolded, $\times 16$.
,, 4.—Second maxilla, $\times 16$.

Gennadas alcocki, sp. nov.

- FIG. 5.—Left-half of the petasma, $\times 16$.
,, 6.—The apex seen from the other side, $\times 30$.
,, 7.—Antennal scale, $\times 8$.
,, 8.—Thelycum, $\times 16$.

Gennadas scutatus, Bouvier.

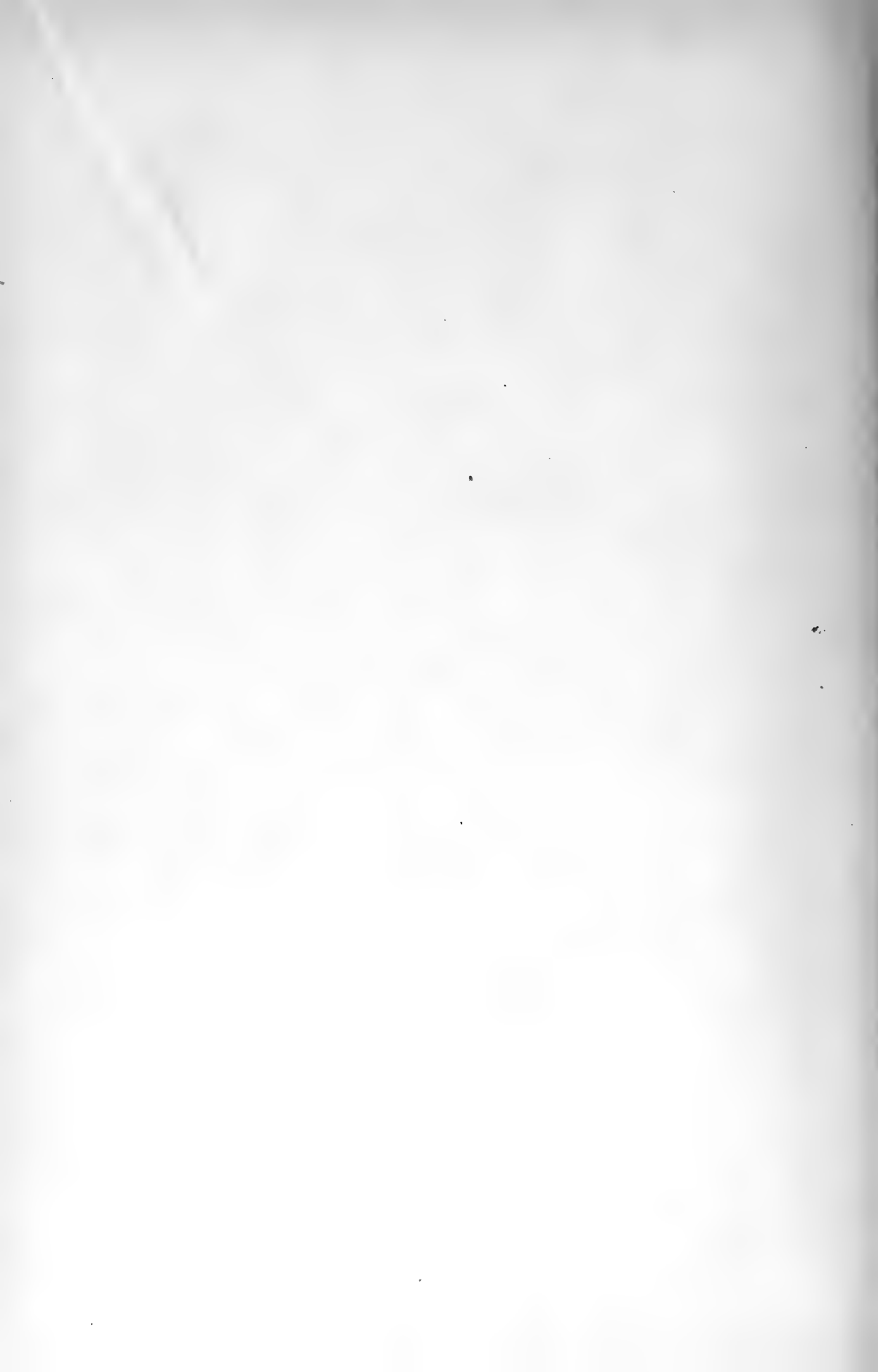
- FIG. 9.—Part of the second maxilla, $\times 70$.
,, 10.—Left-half of the petasma, $\times 30$.



1-4. *Gennadas praecox*.

5-8. *Gennadas alcocki*.

9, 10. *Gennadas scutatus*.



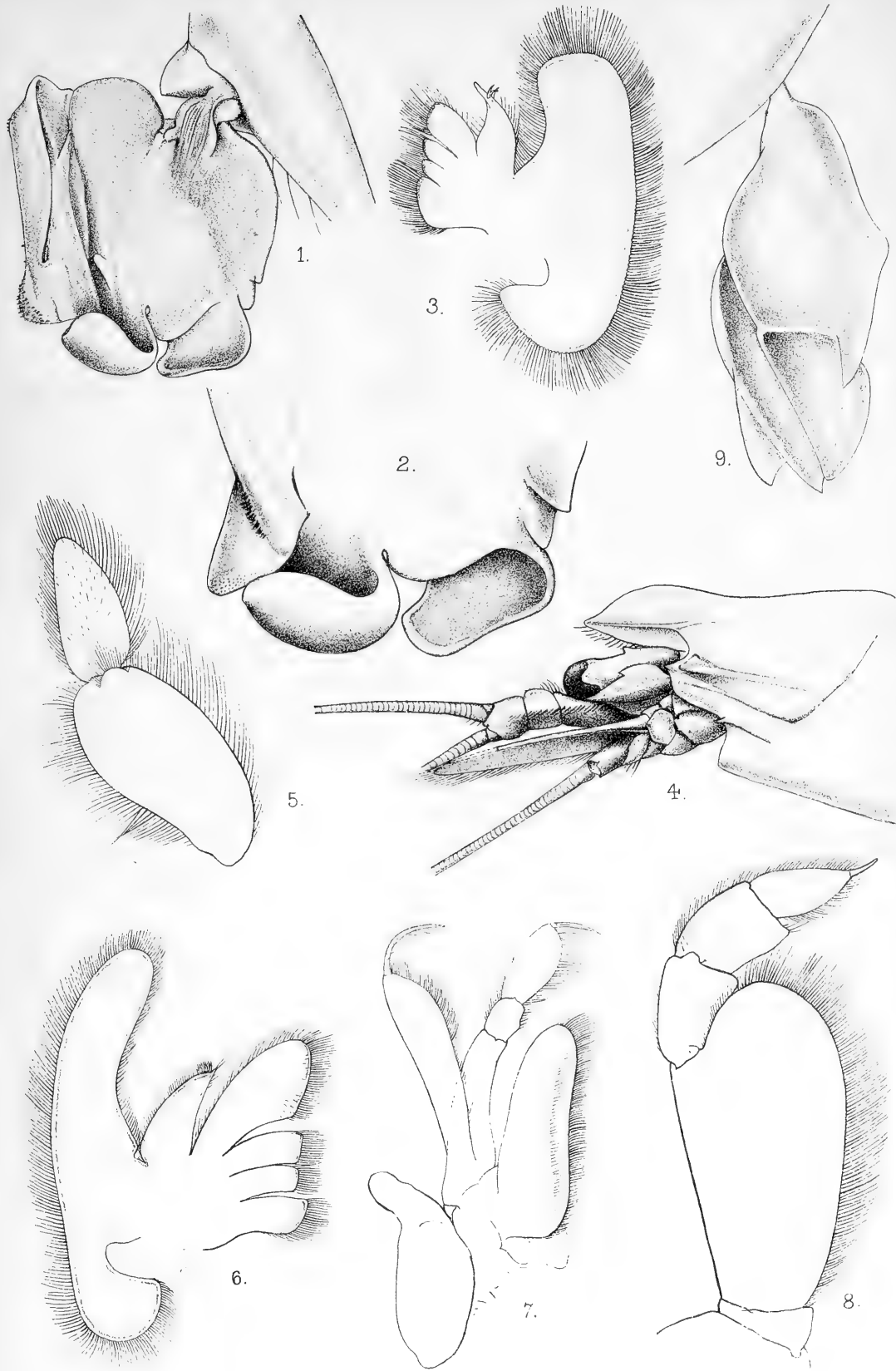
EXPLANATION OF PLATE XIV.

Gennadas sordidus, sp. nov.

- FIG. 1.—Left-half of the petasma, $\times 22$.
,, 2.—Apex of the petasma of another specimen, showing the lobes reflected in a different manner.
,, 3.—Second maxilla, $\times 20$.

Gennadas carinatus (Smith).

- FIG. 4.—The front part of a female specimen seen laterally, $\times 1\frac{1}{2}$.
,, 5.—Mandibular palp, $\times 3$.
,, 6.—Second maxilla, $\times 3\frac{2}{3}$.
,, 7.—First maxillipede, $\times 3\frac{2}{3}$.
,, 8.—Endopod of the second maxillipede, $\times 3\frac{2}{3}$.
,, 9.—Right-half of the petasma, $\times 5\frac{1}{2}$.



1-3. *Gennadas sordidus*.

4-9. *Gennadas carinatus*.



XVIII. DESCRIPTION OF A NEW SPECIES
OF *NEMACHILUS* FROM NORTHERN
INDIA.

By B. L. CHAUDHURI, B.A., B.Sc., Assistant Superintendent,
Indian Museum.

Nemachilus mackenziei, sp. nov.

Br. III, D. II. 11-13, P. 12, V. 8, A. I. 6-7, C. 18.

Length of head 4, height of body $4\frac{2}{3}$, length of caudal $3\frac{1}{2}$ to 4 and the distance of cloacal opening from the root of caudal $3\frac{1}{2}$ in the total length. Breadth of body $1\frac{1}{5}$ in its height.

Head.—Upper profile a straight line from nape of neck to behind the nasal pits, from which point it curves and suddenly slopes down. Shape of head cylindrical, being almost of equal height and breadth, both of which measurements are contained $1\frac{1}{2}$ times in the length of head. There is a small slit or depression on each side in front of the eyes which in the male is bordered by a ridge extending like a small pad to below the eye on each side, where it terminates in a small rounded knob-like hanging flap.

Eyes comparatively large, being $3\frac{1}{2}$ to 4 diameters in the length of the head, $1\frac{1}{5}$ to $1\frac{1}{2}$ in the length of the snout and 1 to $1\frac{1}{5}$ diameters apart; the intraorbital space nearly flat.

Barbels.—6 in all, 4 rostral and 2 maxillary; the outer rostrals are the longest, reaching below the hind margin of the eye and the maxillary reaches beyond them; the inner rostrals reach below the anterior margin of the orbit.

Lips rather thin for the genus. The ends of the suctorial band meet at the middle of the lower lip. The ends are slightly expanded and curved up, thus making the lower lip look interrupted medially. No spine-like process projecting from the middle of the lower lip.

Fins.—The dorsal is in advance of the middle point as well as of the ventral fin. There is a short thick appendant in the angle between the outer margin of the ventral fin and the body. The length of the pectoral fin is contained $1\frac{2}{5}$ in the interval between pectoral and ventral fins while the lengths of the ventral and anal fins are contained $1\frac{4}{5}$ and $1\frac{1}{5}$ in the intervals between the ventral and the anal and the anal and the caudal, respectively. The outer margin of the caudal is rounded and is bilobed, being divided by a notch in the middle.

Shape of body.—Slightly compressed. The anterior end of the root of the dorsal fin is the highest point, the upper profile is almost a straight line with a slight concavity behind the dorsal fin

as the hinder part of the body gradually tapers a little towards the root of the caudal fin. The ventral profile is somewhat curved, with the convexity downwards, the lowest point being the anterior root of the ventral fin.

Lateral line.—Complete, generally follows the curvature of the ventral rather than that of the dorsal profile; in the anterior one-third it slightly curves downwards then upwards to reach the upper corner of the opercle.

Scales of moderate size, all over the body except on the head.

Air-bladder very much reduced and enclosed in paired osseous capsules placed dorsally behind the gills.

Colour.—Head down to the level of the eye dark brown or grey with black patches and spots interspersed irregularly. Body above the lateral line dark brown or grey divided by obliquely transverse thick black bands looping round the back and extending to below the lateral line, the interspaces being often quite as broad as the bands; 5 to 6 such bands in front of the dorsal fin, 4 to 6 below the fin and 5 to 6 behind it. The ground colouring of the sides of the abdomen below the lateral line is of lighter brown to pale yellowish white dashed with silver; the part of the sides immediately below the lateral line is characteristically marked with 12 or 13 wedge-shaped blackish brown or grey inverted-cone-like markings the apices of which reach some distance below the lateral line, along which the bases of these cone-shaped markings run. These markings appear to be in reality the intercepted terminals of the transverse bands mentioned above. The interspaces between the cones are broader than the breadth of their bases. About the middle of the interspaces a fainter and narrower series of grey or pale brown interrupted markings are noticed which are detached below the lateral line, and disappear above the apices of the cones. These faint markings make the darker cones still more conspicuous. Fins: the dorsal fin is pale brown or grey with five or less black or brown bands made up of spots; the caudal is also pale brown and is banded with six black or brown convex curves in some (one Naini Tal and one Champaran specimen) and wedge-shaped in others (Saran and Champaran specimens). The convexity of the curves and the apices of the cones, as the case may be, always pointing outwards (posteriorly). The pectoral, ventral and anal are not banded but are pale yellow to dull white, being somewhat similar to the lower abdomen. There is a black ocellus on the upper border of the root of the caudal fin.

Secondary sexual characters.—There are two male secondary sexual characters to be noticed in the type specimens from Cheriya-dhang (U. P.), firstly, a slit-like deep groove in front of the eye which bends round a small knob-like rounded flap of skin protruding below the anterior one-third of the orbit, the ridge above the groove appearing slightly swollen and cushion-like; secondly, there is a kind of padding and thickening on the upper surface of the pectoral fins, where, on the padding, minute hooked denticular outgrowths are noticed.

Two specimens (of which one is a sexually mature male measuring 7.5 cm.) were obtained by a Museum collector in a small stream at Cheriadhang near Kathgodam and one at Jaulasal, in the Naini Tal district (U. P.), at the base of the W. Himalayas. Seven specimens were collected by Mr. Mackenzie from the Jharai and the Jamwari Nadi near Siripur in the district of Saran (Bengal), and two specimens (the bigger being a sexually mature female measuring 7.4 cm.) were obtained by Mr. Walker from a *jhil* at Purnahia (P. O. Ghorasan) in the district of Champaran.

There is some superficial resemblance between this new species and *N. rubidipennis*, which is reported only from Tenasserim (Burma), and the type of which is in the Indian Museum collection. From *N. rubidipennis* the new species differs in many important characters, especially in the shape of the head; also in the number of fin rays, shape and markings of caudal fin, proportional lengths of barbels and in several other particulars.

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XIX. NOTES ON THE LARVÆ OF *TOXORHYNCHITES IMMISERICORS*, WLK.

By C. A. PAIVA, Assistant, Indian Museum.

In the course of a "census" of the mosquitoes of Calcutta that is being undertaken by the Indian Museum, I have been able to make the following notes on the larvæ of *Toxorhynchites immisericors*, Wlk., which are very common in some parts of the fringe area of the town, especially in the months of June and July. Large numbers of the larvæ and pupæ of this species have been found in earthen pots.

Mr. E. E. Green of Ceylon, in his paper on the development of this mosquito, on p. 161 of the *Spolia Zeylanica*, vol. ii (1905), mentions that its larva is carnivorous and feeds on the larvæ of *Culex*. He mentions also that the larva feeds on others of its own species, the largest and strongest being the only survivor. Mr. Green never found more than one larva at a time. The breeding places where he discovered these larvæ were hollow stumps of the giant bamboo and small pools in the angles of the branches of other trees. Larvæ of *Toxorhynchites* have not yet been found in such places in Calcutta, but in earthen pots not only single individuals have been found, but as many as nine and ten together. In such cases no larvæ of any other mosquito have been found.

As it was suspected that the larvæ must have devoured those of *Stegomyia fasciata* that are usually common in earthen pots, and to prove that *Stegomyia* larvæ were palatable to them, on the 16th July, 1910, a number of *Stegomyia* larvæ were introduced into a bottle containing about half a dozen *T. immisericors* larvæ. Not a minute elapsed after the former larvæ were put into the bottle, before each *T. immisericors* larva had seized one of them and was devouring it with apparent relish. The way the prey is seized seems interesting. It must first be remarked that the larvæ of *T. immisericors* are very sluggish and cannot swim very fast.

Mr. Green mentions that although he watched a larva of *T. immisericors* seizing a *Culex* larva he was unable to see the exact method of catching the larva. He, however, discovered that the falcate lamellæ, which are situated on each side of the head, were the organs of prehension. Each of these lamellæ, according to Mr. Green, is minutely toothed at its extremity. The mode of capture, as has been noticed in the specimens kept under observation in the Indian Museum, is as follows:—

The larvæ of *T. immisericors* lie quietly at the surface of the water, with their bodies generally in a vertical position, and the

Stegomyia larvæ move about quite rapidly. The moment a *Stegomyia* larva comes swimming about near a larva of *T. immisericors*, the latter makes a slight, sharp, sideward jerky movement of the head, which enables it to seize its prey, if within reach. The captured larva struggles for some time to extricate itself.

The large larvæ are not always successful in catching the *Stegomyia* larvæ, as it often happens that the *Stegomyia* larvæ are quite prepared for the attack, and any slight movement on the part of their enemy is sufficient warning to make them sink below "catching range." Larvæ of *T. immisericors* have been seen to devour each about half a dozen *Stegomyia* larvæ within an hour.

The *Stegomyia* larvæ do not leave their enemies in peace. They get near the body of the larger larva, especially the hind portion, and keep nibbling at the bristles that grow on each abdominal segment. This seems to annoy the other larva and with a jerky movement of its body it disperses the *Stegomyia* larvæ, which come back swimming over its head. The first *Stegomyia* larva that comes within reach is instantly seized and sucked quite dry. The empty larval skin is then rejected by the larva of *T. immisericors* by a backward movement of the forepart of the body. This empty skin seems to be sought for by the other *Stegomyia* larvæ, who devour it quite greedily. So occupied was one *Stegomyia* larva in devouring one of these empty larval skins that it did not notice that it had drifted towards a larva of *T. immisericors*. As soon as the former came within reach, the larva of *T. immisericors* seized it and killed it. Many *Stegomyia* larvæ are killed by the larvæ of *T. immisericors* simply because they come and annoy the larger larvæ when they are resting quietly at the surface of the water.

The larvæ of *T. immisericors* do not usually only suck the larvæ of *Stegomyia*. When they are hungry they generally eat them up entirely. In the course of one night over one hundred *Stegomyia* larvæ, besides three larvæ of *T. immisericors*, were eaten up by three other larvæ of *T. immisericors*. In the evening of the 19th July, 1910, the same three larvæ were left in a finger-bowl of water with about twenty *Stegomyia* larvæ. Evidently during the night two of these larvæ of *T. immisericors* had pupated, and the third larva, after it had finished all the *Stegomyia* larvæ, and finding nothing to eat the next morning, seized one of the pupæ and had sucked it nearly dry by 10 A.M. The pupa was seized on the left side of the head, nearer the eye, but between the eye and the respiratory syphon. The larva had got such a firm hold of it that it had some difficulty in getting rid of the empty case. It wriggled about a great deal, till at last it was able to cast away the empty pupal case.

Although it had had such a large supply of food at 10 A.M., it was again ready for some more. At 11 A.M. some twenty larvæ of *Desvoidia obturbans*, from a cess-pool, were introduced into the bowl, as well as another larva of *T. immisericors*, which had been starving all the previous night. Within a couple of minutes each

larva of *T. immisericors* had taken possession of a *Desvoidea* larva. They could not eat these larvæ as fast as they ate the *Stegomyia* larvæ, and although the greater portion of one *Desvoidea* larva had been sucked quite dry, its head and tail wriggled about as if it (the *Desvoidea* larva) wanted to extricate itself from the clutches of the other larva. In most cases the *Desvoidea* larvæ are seized just behind the head, which renders them helpless to attack their enemies, as these larvæ, too, have been observed to eat other mosquito larvæ.

The larvæ of *T. immisericors* will eat any mosquito larvæ. Larvæ of *Culex* and *Myzomyia* were also put into the bowl together with eleven additional larvæ of *T. immisericors* in different stages of growth and evidently hungry, for they seized whatever came in their way first. One small larva of *T. immisericors* did not take more than a minute to finish a larva of *Myzomyia rossii*. On the evening of the 20th July, 1910, over fifty larvæ consisting of *Culex*, *Desvoidea* and *Myzomyia* were placed in the same bowl, with twelve larvæ of *T. immisericors*. By 10 A.M. of the following day there was no trace of a single living larva of any of the three kinds in the bowl. Moreover, a large larva of *T. immisericors* had also been half eaten by another of nearly the same size as itself. I have preserved it in this condition in alcohol, as well as another larva of *T. immisericors* in the act of devouring a *Desvoidea* larva.

One peculiarity about the larvæ of *T. immisericors* and their selection of their prey with regard to its size, is that if various sizes of larvæ are placed in the receptacle in which they are, the larger larvæ of *T. immisericors* will first devour all the other large larvæ of other mosquitoes, leaving the smaller ones to the last. The smaller larvæ of *T. immisericors* will seize those of the smaller kind, but they do not hesitate to tackle a *Desvoidea* larva, although they are very slightly bigger than *Desvoidea* larvæ themselves. I have not yet observed a larva of *T. immisericors* devour another of its own kind when there is a plentiful supply of other larvæ in the receptacle in which it is. In fact it seems to be its last resource when no other larvæ can be had. Otherwise, when the larvæ of *T. immisericors* are confined to small receptacles of water, they will eat any kind of larvæ they get. They display no choice with regard to their food, and as they are carnivorous in habit, they will readily eat whatever larvæ come in their way. If five or six specimens of this larva are put each into a pot or pan containing water and in which there are mosquito larvæ, it will be found that within one night all the other larvæ will be devoured. The carnivorous larvæ seem to be plentiful enough round Calcutta and may also be found within the limits of the town itself, as adult specimens have been found in numbers in a garden centrally situated in Calcutta.

It has been found, as is shown by these notes, that the larvæ of *T. immisericors* feed greedily on the larvæ of *Stegomyia*, and as *S. fasciata*, the yellow fever mosquito, is very common in earthen

pots round Calcutta, one is justified in assuming that *T. immiseri-*
cors plays an important part in its destruction, in a manner which
would be of great moment in the event of yellow fever being intro-
duced into this country.

XX. DESCRIPTION OF A SOUTH INDIAN
FROG ALLIED TO *RANA CORRUGATA*
OF CEYLON.

By N. ANNANDALE, D.Sc., F.A.S.B., Superintendent,
Indian Museum.

Rana travancorica, sp. nov.

No glandular lateral fold. Vomerine teeth in two stout almost transverse groups behind the level of the choanæ; lower jaw with a pair of small tooth-like prominences in front; no free papilla on the tongue. Head large, flat; snout short, rounded, without canthus rostralis; upper eyelid very narrow; eyes prominent, turned upwards; tympanum hidden. Fingers short, blunt, first not extending so far as second; toes short, ending in small but distinct disks, three-quarters webbed; subarticular tubercles small; no outer tubercle; a broad tarsal fold. Hind limbs stout; the tibio-tarsal articulation barely reaching the ear. Skin of back corrugated, with strong but somewhat irregular transverse plaits; skin of throat longitudinally plicated. Dark grey above, obscurely spotted with a darker shade; a pale cross-bar between the eyes sometimes visible; throat and lower surface of thighs profusely clouded with brown. Male without vocal sacs.

Length from snout to vent 40 mm. ($1\frac{3}{5}$ inches).

This species evidently represents in Travancore the Ceylon species *R. corrugata*, from which it may be distinguished by its very much stouter vomerine teeth, less fully webbed hind feet, shorter hind legs and more strongly corrugated dorsal surface. I have examined several specimens taken by Mr. R. Shunkara Narayana Pillay of the Trivandrum Museum in April and May, 1909, at Eathancaud and at Anachardie in the Ariankavu Range near Shencottah on the Madras frontier.



XXI. CONTRIBUTIONS TO THE FAUNA OF
YUNNAN BASED ON COLLECTIONS
MADE BY J. COGGIN BROWN, B.Sc.,
1909—1910.

INTRODUCTION.

By J. COGGIN BROWN, B.Sc., F.G.S., *Geological Survey of
India.*

The collections which form the subjects of these reports were made for the most part in the western districts of the province of Yunnan, in the years 1909-1910.

Yunnan is the most westerly province of the Chinese Empire, and comprises an area of about 150,000 square miles lying roughly between the 21st and 29th degrees of latitude north of the equator, and between the 98th and the 106th degrees of longitude east of Greenwich. It is bounded on the west by Burma, on the south by Tongking, on the east by the provinces of Kuang-si and Kwei-chou and on the north by the province of Ssu-chuan and by Tibet. The whole province is exceedingly mountainous, and its western part is sculptured by a series of great rivers, the Shweli, Salween, Mekong, and upper waters of the Black and Red rivers of Tongking. The basins of these rivers are separated by high mountain ranges, which towards the north-west often attain a height of 15,000 to 20,000 feet whilst the lowest river valleys have an elevation of about 7,000 or 8,000 feet. Orographically this region is connected with Western Ssu-chuan and Tibet, and it is not surprising to find a Tibetan mammalian fauna extending into it.¹ The climate is colder here than in other parts and snow is liable to fall at any time. Many of the mountain ranges are bare, but large forests of fir, cedar and other trees exist in places. Towards the south the heights decrease, until in the extreme south the tops of the hills run down to as low as 5,000 feet, and the bottom of the river valleys are sometimes below 2,000 feet. At the same time there are many exceptions to this rule and peaks of over 11,000 feet are known in the south-west. Further to the east the country opens out, and becomes more plateau-like, there are larger stretches of level ground and the ascents to the hill tops are not so steep or extended. At the same time it must not be supposed that this part of the province is not mountainous, though it is less so than the more western parts. Large plains of

¹ See "On the collection of mammals brought from Yunnan by Prince Henry of Orleans," by E. de Pousargues. Appendix B in "From Tonkin to India," by Prince Henri d'Orleans. English translation by Hamley Bent, London, 1898.

fluvial and lacustrine origin, often containing lakes and surrounded on all sides by mountains, prevail over this area and have been estimated to comprise one-fifteenth part of the province and to contain nearly half of the population. The general elevation of the plains may be taken as 5,500 feet with the mountain tops reaching another 3,000 or 4,000 feet above them.

The climate of these regions is excellent. During the dry season which lasts from November to May, there is no great heat. In the winter months frost is common at night, but snow rarely falls and all through the day the weather is usually bright and pleasant. The general precipitation of the rainy season, which lasts from June to September, is high, though the actual rainfall varies much locally. Long intervals of fine weather are, however, frequent enough in the rains. The plains of the west are all intensely cultivated, highly organised systems of irrigation bring the water from the mountain sides on to the fields, and incidentally prove a means of destruction of the young fish, which are swept down on to the fields and easily secured by the people. The principal crop is rice, which is reaped in October, after which the fields are planted again with the winter crops of poppy, wheat, beans and peas. Maize, hemp, sesamum and other oil producing seeds, tobacco, and in the warmer parts, sugar-cane and tea are also grown. Many of the mountain ranges have been denuded of all large trees, and are now covered with grass and bracken, forming admirable breeding grounds for pheasant, partridge and other game birds, though these are largely kept in check by foxes and various birds of prey.

In the more isolated mountain districts, the slopes are covered with pine woods, and further southwards with trees of a more tropical kind. A recent writer has well remarked, "To a traveller accustomed to the vast jungles of Burma, Yunnan would appear a bare country, but it would seem well wooded when compared to the barren hills of the north-west frontier of India."¹

Evergreen tropical forests exist in the extreme south-west, but further north along the frontier they give place to the evergreen temperate forests which characterise some parts of the Northern Shan States and of the Kachin Hills. In the extreme east of Yunnan and also in small isolated areas about the Burma-China frontier, limestone plateaux are found, which are dry and barren, owing to underground circulation of the water.

The border between the hilly areas of Upper Burma and Yunnan is purely a political and administrative one, ethnographically there is little difference between the indigenous tribes on either side, whilst the classical researches of Anderson have shown that the fauna is much the same. In the same way, north-western Yunnan belongs to the Tibetan region, and southern Yunnan has nothing to distinguish it geographically from those parts of the Southern Shan States and Upper Tongking which it adjoins.

¹ See "Yunnan, the link between India and the Yangtze," by H. R. Davies, pp. 311.

Mammals are by no means common in Yunnan owing to the destruction of the forests and food supplies, and to the extermination of the larger species by hunters. Few opportunities for collecting them arose.

Fishes are plentiful in the larger rivers and lakes, in the smaller streams they are rare, owing to the enterprise of the Chinese. Lake Erh-hai, from which various specimens were obtained, is a picturesque sheet of water 30 miles long and from 5 to 7 miles broad, bounded on the east by low bare hills, and on the west by a narrow but highly cultivated plain which quickly gives place to the Ts'ang Shan mountains rising to 14,000 feet above the sea. This plain contains the city of Ta-li Fu (Long. $100^{\circ} 5'$, Lat. $25^{\circ} 42'$), at an elevation of 6,900 feet above the sea. Along the greater part of the western shore the fields come down to the water's edge, but in places the waves beat up on to extensive shell banks which are largely made up of the remains of *Margarya*. Water-weeds flourish for many yards out from the shore and provide food and shelter for various forms of aquatic life. Fish are very plentiful and fleets of junks are always engaged in netting them. In the shallow waters near the shore, the smaller kinds are caught by the aid of a trained diving bird which appears to be a kind of cormorant. The fishing industry is in the hands of the Minchia, a tribe of aborigines who inhabit the Ta-li Fu plain. All round the shore wading birds find their food, while ducks of many kinds are to be seen on the waters. In the outlet of this lake near Hsia-kuan almost the only sponges found in Yunnan up to the present, are to be obtained. They consist of small rounded or irregular growths of a brilliant green colour, which grow on pieces of stone, wood or old shells.

In Western Yunnan insect life is not very abundant, probably on account of the temperate climate, but further southwards a great variety prevails.

Few reptiles were seen, the specimens which were obtained coming mainly from the rocky lava-covered downs of the Tengyueh district. Batrachians are common on the flooded fields in the early part of the year. The Salamander *Tylototriton verrucosus*, Anderson, is common in damp ditches and old walls around Tengyueh.

I wish to express my thanks to Dr. N. Annandale, Superintendent of the Indian Museum, who supplied me with a complete collecting outfit and through whose kind offices I was given a grant of Rs. 500 to meet expenses, without which it would have been impossible to have carried out this work.

LIST OF PRINCIPAL PLACES AND DISTRICTS FROM WHICH
SPECIMENS WERE COLLECTED.

Name.	District.	Longitude E.	Latitude N.	Elevation (feet above sea level).
Bhamo	In Upper Burma	97° 13'	24° 15'	361
Tengyueh .. ..	....	98° 33'	25° 2'	5,365
Yung-chang Fu .. ..	....	99° 5'	25° 7'	5,400
Chu-tung	Yung-ping Hsien	99° 26'	25° 27'	5,500
Yang-pi .. ..	....	99° 53'	25° 38'	5,200
Hsia-kuan	Ta-li Fu ..	100° 6'	25° 35'	6,700
Ta-li Fu .. ..	....	100° 5'	25° 42'	6,800
Yunnan Fu .. ..	....	102° 45'	25° 2'	6,400
Shan Kuan	Ta-li Fu ..	100° 9'	25° 55'	6,800
Pu-piao	Yung-chang Fu ..	98° 58'	25° 2'	4,600
Ma-chan-kai	Tengyueh ..	98° 30'	25° 20'	6,000
Pe-lien	Tengyueh ..	98° 34'	25° 11'	5,800
Ku-tung-kai	Tengyueh ..	Very close to Ma- chan-kai.		6,000
Lung-ling .. ..	....	98° 43'	24° 37'	5,100
Lahsa .. ..	....	97° 53'	24° 25'	4,500
Lo-po-ssu-chuang or Mong Hum.	....	98° 15'	24° 42'	5,100
Mong Wan or Lung-chuan	....	97° 59'	24° 20'	3,100
Man Hsien .. ..	....	97° 48'	24° 30'	2,800
Nan Tien or Mong Ti ..	....	98° 22'	24° 52'	3,800
Mong Hsa .. ..	....	99° 32'	23° 43'	4,550
Mong Pan .. ..	....	100° 23'	23° 7'	5,500
Lu-shui-ho	Hui-li Chou (in the province of Ssu- chuan).	102° 3'	26° 15'	6,200 ?
Kuan-ping	Yun-lung Chou ..	99° 31'	25° 51'	7,100
Ta-lu	Yung-pe Ting ..	100° 50'	26° 37'	7,800
Ta-shui-chai .. ..	....	A village in the Lo-po- ssu-chuang valley.		3,900
Wei-yuan Ting .. ..	....	100° 44'	23° 30'	3,200
Yun-Chou .. ..	....	100° 6'	24° 27'	3,800
Ssu-mao .. ..	....	101° 2'	22° 45'	4,900
Ching-tung Ting .. ..	....	100° 57'	24° 27'	3,900

Note.—With the exception of the two places noted, all the localities are situated within the province of Yunnan.

PART I.—SPONGES AND POLYZOA.

By N. ANNANDALE, D.Sc., F.A.S.B., *Superintendent,
Indian Museum.*

SPONGES.

1. *Spongilla* (*Euspongilla*) *proliferens*, Annandale.

A small dried specimen on a piece of stick from a lake full of weeds at Mong Pan (alt. 5—6,000 feet), W. Yunnan. This species was also taken by Mr. Coggin Brown at Prome in Upper Burma.

2. *Spongilla* (? *Euspongilla*) *yunnanensis*, sp. nov.

Sponge hard, coherent, light, forming small rounded masses of a dull greenish colour (dry); the surface smooth; no branches; the oscula conspicuous, level with the surface, circular, of moderate size, with well-defined borders; the external membrane adhering closely to the sponge, stretched over a con-

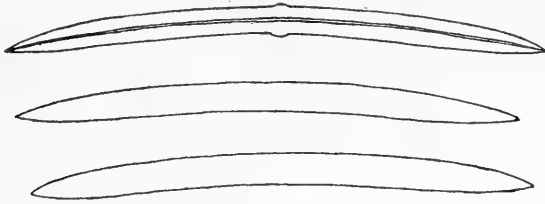


FIG. 1.—Skeleton spicules of *Spongilla yunnanensis*, Annand.

siderable part of each osculum; an ill-defined basal chitinous membrane present.

Skeleton moderately loose, not very regular; the radiating fibres well defined but slender; the transverse fibres distinct, situated somewhat widely apart; a considerable amount of spongin present.

Spicules.—Skeleton spicules (fig. 1) smooth, sharp, moderately slender, measuring on an average 0.246×0.016 mm., as a rule nearly straight but not infrequently bent at an angle. No flesh spicules.

Gemmules not observed.

Habitat.—South outlet of Lake Ta-li Fu (Erh-hai), Yunnan, W. China; alt. 6,900 feet. Specimens taken at the beginning of March, 1910.

It is always dangerous to describe specimens of Spongillidae without gemmules as the types of species, but *S. yunnanensis* resembles *S. philippinensis* so closely in general structure that the two species must be closely allied. The former is distinguished by its smooth spicules and stronger skeleton. The type specimen measures $35 \times 35 \times 40$ mm. and is attached to a small stone.

3. *Spongilla* (? *Stratospongilla*) *coggini*, sp. nov.

Sponge not very hard, fragile, tomentose, of a brilliant green colour, forming irregular masses of moderate size, occasionally with short flattened branches; the oscula inconspicuous, usually situated in depressions on the surface; external membrane closely adherent to the sponge; a well-defined but delicate chitinous basal membrane present.

Skeleton close but not very coherent, forming an almost regular net-work with comparatively small meshes; radiating and transverse fibres of almost equal diameter; very little spongin present.

Spicules.—Skeleton spicules (fig. 2) moderately stout, measuring on an average 0.272×0.02 mm., pointed or rounded at the ends, as a rule straight or nearly straight; their surface minutely but not closely spined, the spines straight, becoming closer and slightly longer near the extremities, which usually

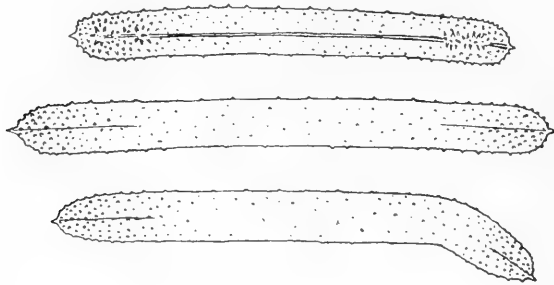


FIG. 2.—Skeleton spicules of *Spongilla coggini*, Annand.

terminate in a single spine of larger size than any of the rest.

Gemmules of moderate size, few in number, flattened at the base, dome-shaped above, with a central indentation or concavity; their chitinous coat thin and brittle, covered by a delicate outer membrane in continuity with the basal membrane of the sponge; no granular or cellular pneumatic coat; no foramen; no gemmule spicules.

Habitat the same as that of *S. yunnanensis*, together with which this species was taken.

The specimens of *S. coggini* vary considerably in size, but the largest does not measure more than $50 \times 40 \times 38$ mm. There are a great many of them, the majority being evidently complete. Many small stones and dead *Corbicula* and *Margarya* shells are included in their substance. I can find no trace of microscles, but the gemmules seem to be fully formed, their outer coat being covered with diatoms, organic debris and small fragments of silica apparently of natural shape.

S. coggini is evidently a close ally of *S. clementis*, which was discovered, together with *S. philippinensis*, in Lake Lanao in the Philippines. *S. clementis*, however, has smooth skeleton spicules and the gemmule is armed with microscleres. It is interesting that the two sponges found in Lake Ta-li Fu should be so like the two from Lake Lanao; but our knowledge of the fauna of both lakes is still incomplete.

POLYZOA.

? *Plumatella javanica*, Kraepelin.

A dried specimen from Mong Pan, taken together with the specimen of *S. proliferens* referred to above, appears to belong to this form, which is common in northern India and Burma.



MISCELLANEA.

REPTILES.

NOTES ON THE DARJILING SKINK (*Lygosoma sikkimense*).—On several occasions during the "rains" I have found small lizard's eggs hidden in little pockets in the damp moss on tree-trunks near Kurseong, without being able to assign them to any species. There can now be no doubt that their parent is *Lygosoma sikkimense*. As most skinks are ovoviviparous, the fact is interesting. Two clutches of four eggs each were found at an altitude of 4,700 feet in the last week of June. Those of one were allowed to become dry, and shrivelled up. The embryos in them were in an early stage of development. The other clutch was brought alive to Calcutta and apparently lived for about a fortnight, without hatching. The eggs were dissected on July 12th and found to contain perfectly formed little lizards, dead but not decomposed. They had a stiff but not calcareous white shell and measured 10 mm. \times 6 mm., the ends being equally rounded. The young lizards had bright red tails and measured about 37 mm. when stretched out.

I may here state that I obtained last year a specimen of Stoliczka's "*Mococa sacra*," the type of which is in the collection of the Indian Museum, from the top of Paresnath Hill in Chota Nagpur. An examination of the two specimens, which must have been found in closely adjacent spots, shows beyond a doubt that the species they represent is identical with *Lygosoma sikkimense*, as Boulenger stated it to be. But I have been able to obtain no evidence of the occurrence of this lizard in any locality intermediate between the Himalayas and Paresnath, which is separated from them by the whole breadth of the Ganges valley but is the only mountain in Bengal proper that reaches an altitude of over 4,000 feet.

N. ANNANDAILE,
Superintendent, Ind. Mus.

INSECTS.

COCKROACHES AS PREDATORY INSECTS.—As actual records of cockroaches acting as predatory insects appear to be rare, the following note has some biological interest. On the evening of June 9th, during a heavy downpour of rain, numerous termites flew into my dining room in Calcutta and were borne to the floor by the currents of air set up by the electric fan. As they lay struggling many of them fell a prey to a lizard (*Hemidactylus flaviviridis*), while others were devoured by cockroaches (*Periplaneta*

americana). Each cockroach stood over one of the termites with its legs spread out and firmly planted and, seizing the struggling insect in its jaws, began to gnaw the abdomen. If disturbed the cockroach carried the termite away in its mandibles, making no use of its legs in seizing, holding or carrying the prey. Sometimes the whole body except the wings was devoured, sometimes only the abdomen. The termite lived for a considerable time after being attacked.

N. ANNANDALE,
Superintendent, Ind. Mus.

NOTE ON *Edeomyia squammipenna*,¹ ARRIBALZAGA.—At the latter part of December, 1909, I paid a visit to Bhogaon and Katihar in the Purneah District, N. Bengal, and while I was engaged in examining the trunks of old mango trees in quest of Ascalaphid larvæ, my attention was attracted by some small insects which took to flight on the tree trunks being touched. I could not at first discover what these insects were, as I could not notice anything moving about on the portion of the bark before me. After a closer examination I discovered that several specimens of the above species of mosquito were resting on the bark and as their colour so much resembled the dirty colour of the tree bark, it rendered it difficult to see them. Apparently they took shelter on these old trees as a kind of protection from any injury. I examined younger trees with the bark comparatively smooth, but failed to find any specimens.

Although these mango trees are quite close to a house I found no specimens in the house at Bhogaon, neither by day nor at night.

Mr. Theobald states that it inhabits houses and bites, but according to Dr. Lutz it has not been observed to sting in South America. I found 6 females and 8 males resting on mango tree trunks at Bhogaon and 4 males resting on a wall inside a house by day at Katihar. All these specimens agree with the specimens in the Indian Museum collection which have been examined by Mr. Theobald. They also agree with Theobald's description. This species has previously been recorded from British Guiana, Brazil, Argentine, Madras, and Perak (*Theobald*), and the Museum possesses two ♀ specimens, one from base of Dawna hills, Lower Burma, "taken in bungalow," 2-iii-08 (*Annandale*), and the other at light on board ship, 4 miles off Tuticorin, S. India, 25-v-08 (*C. Paiva*). This species appears to be rare in India.

C. PAIVA,
Assistant, Ind. Mus.

NAMED SPECIMENS OF CHRYSOMELIDÆ IN THE INDIAN MUSEUM.—By request of the Superintendent I have examined

¹ Theobald, *Monogr. Culicid.*, ii, p. 219 (1901).

the Chrysomelidæ belonging to the divisions Eupodes, Camptosomes and Cyclica in the collection of the Indian Museum, and have drawn up the following list. In preparing it I have followed Jacoby's volume on the Chrysomelidæ of the "Fauna of British India," and have not attempted to identify the species not referred to therein. It is to be hoped that the list, though not exhaustive, will be of some use to students of geographical distribution by placing in their hands a catalogue of named specimens in the collection of the Indian Museum.

The numbers quoted after the name of each species are those of the "Fauna" volume on the Chrysomelidæ.

EUPODES.

Subfamily SAGRINÆ.

Sagra femorata, Drury (1).

Locality.—Mysore State, S. India.

It is distributed throughout India and China extending to Borneo and Java.

Sagra carbunculus, Hope (8).

Localities.—Mungphu and Kurseong, E. Himalayas (*Lynch*).

Also recorded from Sylhet, Assam. It is apparently confined to N. E. India.

Sagra multipunctata, Jac. (10).

Locality.—Sibsagar, Assam.

Jacoby records this species from Bhamo, Upper Burma.

Subfamily DONACINÆ.

Donacia æraria, Baly (12).

Geographical distribution.—India, Burma, Ceylon, Malay Peninsula, (?) Japan.

Jacoby doubts whether this insect has in reality the great geographical distribution attributed to it by Baly. All the specimens in the collection of the Indian Museum are from Calcutta. These were caught at light, 10-xii-07 (*Mus. collr.*).

Donacia recticollis, Jac. (14).

Locality.—Calcutta, 10—20-iii-07 and 25-vi-07 (*Mus. collr.*).

Also recorded from Berhampur District in Bengal.

Subfamily CRIOCERINÆ.

Lema globicollis, Baly (32).

Localities.—Bangalore, S. India (*J. Cameron*). Ranchi (*W. H. Irvine*) (*det. Jacoby*). Mandar, Bengal (*det. P. Cardon*). Allahabad, United Provinces, 14-viii-09 (*Lord*).

Lema lacordairei, Baly (38).

Localities.—Sibsagar, Assam (S. E. Peal). Calcutta, 7-vi-07 (*Mus. collr.*). Yunnan (? J. Anderson).

Jacoby records it from Southern India, Malabar and Burma. Evidently this species has a wide geographical distribution.

Lema coromandeliana, Fabr. (41).

Localities.—Calcutta. Bangalore, S. India (J. Cameron). The Andamans (*det.* Jacoby).

Some of the Calcutta specimens were obtained in October and November 1907 (*Mus. collr.*), and some in March 1907 (N. Annandale).

Also recorded from Ceylon, Sumatra and Java.

Lema atkinsoni, Jac. (46).

Locality.—Khulna, Lower Bengal, 10-iii-07 (J. Caunter).

Jacoby records it from Mungphu in Sikkim.

Lema palpalis, Lacord. (50).

Locality.—The Andamans (*det.* Baly).

Also recorded from Bengal, Western India, Sumatra and Java.

Lema impotens, Lacord. (65).

Localities.—Calcutta. Kurseong, E. Himalayas (*det.* Jacoby).

It has not been recorded from any other locality.

Lema lycaon, Jac. (84).

Locality.—Dum-Dum, near Calcutta, 29-viii-09 (Lord).

Also recorded from Belgaum, Bombay.

Lema lateralis, Jac. (90).

Locality.—Siliguri, base of E. Himalayas, 29-vi-06.

It has not been recorded from any other definite locality.

Lema bimaculata, Baly (103).

Locality.—The Andamans (*det.* Baly).

Apparently confined to the Andamans.

Lema quadripunctata, Oliv. (104).

Localities.—Sibsagar, Assam (S. E. Peal). Darjiling, E. Himalayas. N. Borneo. Tavoy. Dunsiri Valley, Upper Assam (Godwin-Austen).

Also recorded from Ceylon, Burma, the Andamans, Sumatra Java.

Lema femorata, Guérin (105).

Localities.—Khasi Hills, Assam (1,000 to 3,000 ft.).

The range of this species extends to Sumatra and Borneo.

Lema terminata, Lacord. (110).

Localities.—Calcutta. Ranchi, Chota Nagpur.

Also recorded from Coromandel.

Lema mandarensis, Jac. (132).

Locality.—Mandar, Bengal (*det.* P. Cardon).

Also recorded from Mahé in Malabar.

Lema nigricollis, Jac. (134).

Localities.—Sikhim (E. T. Atkinson). Buxar Duars, base of E. Himalayas.

Also recorded from Assam; Ruby Mines, Burma.

Crioceris impressa, Fab. (139).

Localities.—Calcutta, 1-vi-09. Purneah District, Bengal. Paresnath, W. Bengal, 4,000 ft., 12-vi-09 (*Annandale*). Rajmahal, Bengal, 6-vii-09 (*Annandale*). Siliguri, base of E. Himalayas, 18-vii-09. Damukdia Ghat, Bengal, 22-vii-09. Cachar and Sibsagar, Assam (S. E. Peal). Khasi Hills, Assam (*Godwin-Austen*). Dunsiri Valley, Upper Assam. Sikhim. Sureil, Darjiling (*Alcock*). Yunnan. Shan Hills, Upper Burma (*J. C. Brown*). The Andaman and Nicobar Islands.

It is also recorded from China, the Malay Archipelago including the Philippines, Siam and Ceylon.

Crioceris semipunctata, Fabr. (140).

Locality.—Dehra Dun, base of W. Himalayas.

Also known from Ceylon and Java.

Crioceris semicostata, Jac. (148).

Locality.—Lebong, Darjiling, E. Himalayas, 5,000 ft., 1-x-08 (*H. M. Lefroy*).

Jacoby records it from Manipur only.

Crioceris quadripustulata, Fabr. (150).

Localities.—Sikhim. Sibsagar, Assam, August 18 (S. E. Peal).

Also known from Tenasserim, Siam and Java.

Crioceris cruciata, Guér. (154).

Locality.—The Nilgiris.

This species has not yet been recorded from any other locality.

Pseudolema suturalis, Jac. (160).

Locality.—Mandar, Bengal (*det.* P. Cardon).

Also known from the Nilgiris.

CAMPTOSOMES.

Subfamily CLYTRINÆ.

Labidostomis humeralis, Schneider.

Locality.—Afghanistan.

All the specimens in the Museum collection are from Afghanistan.

Merilia lunulata, Fabr. (177).

Locality.—Bangalore (*J. Cameron*) (*det.* Jacoby).

Also known from Madras, Coromandel.

Miopristis bimaculata, Jac. (178).

Locality.—Pusa, Bengal (*Pusa coll.*).

Recorded by Jacoby from Chapra, Bengal.

Pseudoclytra plagiata, Duviv. (181).

Locality.—Mandar, Bengal (*det.* P. Cardon).

Also recorded from Madras.

Gynandrophthalma crassipes, Duviv. (199).

Locality.—Konbir, Bengal (*P. Cardon*).

It has been recorded from Konbir only.

A specimen labelled "type" is in the Museum collection.

Etheomorpha nigropicta, Lefèv. (223).

Locality.—Calcutta, 1-vi-09.

Also known from Mandar, Bengal; Tranquebar, Kanara, Belgaum and Ceylon (*det.* Jacoby).

Aspidolopha rugosa, Jac. (246).

Locality.—Mungphu, Darjiling district.

Has not been recorded from any other locality.

Aspidolopha melanophthalma, Lacord. (254).

Localities.—Calcutta, 1-vi-09, 20-ii, 11-iii, 4-ix, 1907. Purneah, N. Bengal. Khulna, Lower Bengal, 11-viii-07 (*J. Caunter*). Rajmahal, 31-vii-07. Siliguri, base of E. Himalayas.

Also known from Tenasserim.

Epimela indica, Duviv. (257).

Locality.—Mandar, Bengal (*P. Cardon*).

Also recorded from Konbir-Nowatali, Tetara.

The specimens were probably identified by the author of the species.

Clytrasoma palliata, Fabr. (264).

Localities.—Bangalore, S. India, 28-viii-76. Kulu, W. Himalayas. Maldah, Bengal. Jhelum Valley (*det. Baly*).

Clytra succincta, Lacord. (267).

Localities.—Waltair, Madras (*E. P. Stebbing*). Mysore, Bangalore (*J. Cameron*). Karachi (*W. D. Cumming*).

It has also been recorded from Bengal; the range extends to China and Java.

Clytra lefevrei, Jac. (271).

Locality.—Mandar, Bengal (*P. Cardon*).

Also known from S. Bombay, Kanara, the range extending to the Nilgiris and Malabar.

Clytra insularis, Lefèv. (272).

Locality.—The Andamans.

It has been recorded from the Andamans only.

Clytra orientalis, Lefèv. (275).

Locality.—Bangalore, S. India.

Known from Bangalore only. Probably identified by the author of the species.

Diapromorpha quadripunctata, Jac. (287).

Locality.—Lahore, Punjab, 8-v-08 (*N. Annandale*).

Also known from the Nilgiris, Kanara, Travancore and Ceylon.

Diapromorpha dejeani, Lacord. (288).

Localities.—Soondrijal, Katmandu and Chonibal in Nepal. Sikkim. Bhim Tal, Kumaon, 4,500 ft., 25-ix-07.

Also recorded from Coromandel and the Malay Archipelago.

Diapromorpha melanopus, Lacord. (291).

Localities.—Calcutta. Rajmahal, Bengal, 5-vii-09 (*Annandale*). Hughli, Bengal, 6-ix-09 (*J. B. Richardson*). Kankandiggi, Sundurbunds, 21-viii-09 (*J. T. Jenkins*). Berhampur, Bengal. Birbhum, Bengal. Mungphu and Kalimpong, Darjiling district.

Also recorded from Siam.

This species is a pest of the mango and *Litchi*. It is also a well-known tea pest in Assam, Cachar and Sylhet.

Diapromorpha pallens, Oliv.

Locality.—Sikhim.

As the specimens were identified by Baly, I include this species in the list.

Diapromorpha turcica, Fab. (293).

Localities.—Bangalore, S. India (*J. Cameron*). Mysore, 4-xi and 6-x, 1876. Trivandrum, Travancore, 13-xi-08 (*Annandale*).

Jacoby records it from Ceylon. This species is apparently confined to Southern India and Ceylon.

Diapromorpha balteata, Lacord. (294).

Locality.—Madras.

Recorded from Southern India only.

Ceratobasis nair, Lacord. (296).

Locality.—Bangalore, S. India (*J. Cameron*) (*det.* Jacoby).

Also known from Bombay, Malabar and Nilgiris.

Coptocephala dimidiatipennis, Baly (300).

Localities.—Jhelum Valley, Kashmir. Assam (*det.* Baly).

Coptocephala dubia, Baly.

Locality.—Murree, W. Himalayas (*det.* Baly).

For description and other notes see *Rec. Ind. Mus.*, vol. ii, p. 406 (1908).

Subfamily CRYPTOCEPHALINÆ.

Cryptocephalus posticalis, Jac. (345).

Locality.—Bangalore, S. India (*J. Cameron*) (*det.* Jacoby).

Cryptocephalus konbirensis, Duviv. (346).

Localities.—Konbir and Mandar in Bengal (*det.* P. Cardon).

Cryptocephalus sikhimensis, Jac. (355).

Locality.—Darjiling, E. Himalayas, 7,000 ft., 8-viii-09 (*J. T. Jenkins*).

Jacoby records it from Sikhim.

Cryptocephalus pusaensis, Jac. (374).

Locality.—Pusa, Bengal (*Pusa coll.*).

Recorded from no other locality.

Cryptocephalus dimidiatipennis, Jac. (397).

Locality.—Lebong, E. Himalayas, 5,000 ft.

Also recorded from Mungphu in Sikhim.

Cryptocephalus deficiens, Suffr. (400).

Locality.—Kurseong, E. Himalayas, 4,000 ft. 6-ix-09 (*Annanale*).

Also known from Assam (*Doherty*). This species is attracted to light.

Cryptocephalus schestedti, Fabr. (404).

Localities.—Madras (*Pusa coll.*). Goalbatham, E. Bengal, 10-vii-09 (*R. A. Hodgart*). Puri, Orissa, 21-i-08. Bandal, Hughli, Bengal, 5-vii-08 (*C. Paiva*). Dum-Dum, near Calcutta, 29-vii-09 (*Lord*).

Also recorded from Southern Bombay, Nilgiris, Malabar and Ceylon.

Cryptocephalus vittipennis, Suffr. (407).

Locality.—Calcutta (*det. Jacoby*).

Also recorded from Mussoorie, W. Himalayas, 7,500 ft., and Patna district in Behar.

Cryptocephalus tricinctus, Redtenb. (419).

Locality.—Kurseong, E. Himalayas, 5,000 ft., 21-v-06 (*Annanale*).

Also recorded from Kashmir and Mussoorie, 7,500 ft., W. Himalayas.

Cryptocephalus sexsignatus, Fabr. (425).

Localities.—Calcutta, 27-vi-08 (*J. B. Richardson*). Patna district, Behar. Rajmahal, Bengal, 31-vii-07. Gopkuda Island, Lake Chilka, N. E. Madras, 7-viii-07. Siliguri, base of E. Himalayas, 30-vi-06. Bangalore, S. India.

Also recorded from Ceylon.

Cryptocephalus analis, Oliv. (433).

Locality.—Kulu, W. Himalayas (*det.* Baly).

Also recorded from Bengal, Nilgiris, Coromandel, Tranquebar.

Cryptocephalus colon, Suffr. (445).

Locality.—Pegu, Burma.

Also known from Assam, Siam.

Cryptocephalus senarius, Suffr. (452).

Locality.—Igatpuri, Western Ghats.

Also known from Surat and Kasara.

Cryptocephalus interjectus, Baly.

Localities.—Southern India. Jhelum Valley and Murree, W. Himalayas (*det.* Baly).

For description and other notes regarding this species see *Rec. Ind. Mus.*, vol. ii, p. 406 (1908).

CYCLICA.

Subfamily EUMOLPINÆ.

Nodostoma concinnicolle, Baly (538).

Locality.—Jhelum Valley (*det.* Baly).

Also recorded from Mandar in Bengal and Kashgar.

Nodostoma plagiosum, Baly (543).

Locality.—Murree, W. Himalayas (*det.* Baly).

Also recorded from the Khasi Hills, Assam, and Kashgar.

Nodostoma variabile, Duviv. (583).

Locality.—Mandar, Bengal (*P. Cardon*).

Also known from Sikkim and Kurseong, E. Himalayas.

Pagria kanaraensis, Jac. (637).

Locality.—Calcutta (*det.* Jacoby).

Also recorded from S. India, Belgaum, Bombay and S. Kanara.

Scelodonta vittata, Oliv. (675).

Localities.—Berhampur, Bengal. Maldah, Bengal. Rajmahal, Bengal, 6-vii-09 (*Annandale*). Tavoy. The Andamans (*det.* Jacoby).

It has been recorded also from Bombay and Cochin China.

Scelodonta indica, Duviv. (678).

Localities.—Calcutta. Mandar, Bengal (*P. Cardon*). Konbir, Bengal.

Scelodonta dillwyni, Stephens (680).

Locality.—Rajmahal, Bengal, 6-vii-09 (*Annandale*).

Jacoby records it from Tenasserim, Borneo and Singapore.

Trichochrysea vestita, Baly (690).

Locality.—Sikhim (*det.* Baly).

Also known from the Khasi Hills in Assam, Bhamo in Burma, and Tenasserim.

Trichochrysea clypeata, Jac. (694).

There is a single specimen in the Museum collection which has no locality. Jacoby records it from Bhamo.

Aoria nigripes, Baly (701).

Locality.—Nongpoh, Khasi Hills, Assam.

Also recorded from Malabar, Burma, China, Sumatra.

Aoria bowringi, Baly (703).

Locality.—The Andamans (*det.* Baly).

Also known from Nepal, the Khasi Hills, Burma, Sumatra and Northern China.

Colasposoma albovillosum, Duviv. (768).

Locality.—Mandar, Bengal (*P. Cardon*).

Also known from Konbir, Tetara, Bengal.

Colasposoma downesi, Baly (772).

Localities.—Sikhim. Darjiling, E. Himalayas. Bangalore, S. India (*det.* Jacoby and Baly).

Also recorded from Burma.

Colasposoma metallicum, Clark (779).

Locality.—Bangalore, S. India (*J. Cameron*) (*det.* Jacoby).

Also recorded from Southern Bombay, Bhamo in Burma, the Andamans and Penang.

Colasposoma cæruleatum, Baly (781).

Localities.—Sibsagar, Assam. Dunsiri Valley, Upper Assam. Maldah, Bengal.

Also known from Southern Bombay, Ceylon, Burma and China.

Colasposoma ornatum, Jac. (791).

Localities.—Calcutta, 16-vii-07. Maldah, Bengal. Nagpur, Central Provinces.

Also known from Belgaum, Southern Bombay.

Colasposoma auripenne, Motsch. (792).

Localities.—Pusa, Bengal. Calcutta and Maldah, Bengal. Southern India. The Andamans.

The distribution extends to Burma, the Malayan subregion, Hong-Kong and China (*det.* Baly).

Colasposoma aureovittatum, Baly (793).

Localities.—Sikhim. Darjiling, E. Himalayas.

Jacoby records it from Assam.

A variety recorded from the Andamans in the collection has been identified by Baly.

This species extends from N. E. India to the Andamans.

As specimens of the following two species were determined by Jacoby I include them in the list, although they are not described in his volume of the "Fauna" series.

Colasposoma nitida, Fabr.

Locality.—Bangalore, S. India (*J. Cameron*) (*det.* Jacoby).

Colasposoma affine, Lefèv.

Locality —Ranchi, Chota Nagpur (*W. H. Irvine*) (*det.* Jacoby).

Abirus angustatus, Lefèv. (795).

Locality.—Southern India.

This specimen was probably identified by the author of the species.

Abirus andamansis, Lefèv. (798).

Locality.—The Andamans.

This specimen was also probably identified by the author of the species.

Pachnephorus bretinghami, Baly (801).

Locality.—Calcutta (*det.* Jacoby).

Also known from Bhamo in Burma, and Sumatra.

Eurypelta modesta, Fabr. (806).

Localities.—Calcutta. Murshidabad, Bengal.

Also known from Mysore.

Corynodes pyrophorus, Parry (852).

Localities.—Sikhim (*de Nicéville*). Darjiling, E. Himalayas. Sibsagar, Assam (*S. E. Peal*). Rungpo in Sikhim, 1,400 ft., 6-ix-09.

Also recorded from Nepal, Burma and China.

Corynodes undatus, Oliv. (854).

Locality.—Rangoon, Burma.

The range of this species is from Burma, Siam, Malacca, Penang to China. It has not been recorded from India.

Corynodes peregrinus, Fuessly (855).

This species is distributed throughout India, Ceylon, Burma, Siam and Malacca.

Corynodes amethystinus, Marshall (856).

Locality.—Igatpuri, Western Ghats, Bombay.

Also known from Kanara, S. Bombay, the Nilgiris and Wal-lardi in Travancore.

Corynodes pyrospilotus, Baly (858).

Locality.—Upper Tenasserim (*det.* Baly).

Jacoby records it from Siam.

Corynodes sheppardi, Baly (861).

Locality.—Mercara, Coorg.

Also recorded from the Nilgiris and Kanara in Bombay.

Corynodes andamanensis, Lefèv. (874).

Locality.—The Andamans.

Heminodes unicolor, Duviv. (889).

Locality.—Mandar, Bengal (*P. Cardon*).

Also known from Bombay and Burma.

S. MAULIK,

Temporary Assistant, Ind. Mus.

CRUSTACEA.

TWO BARNACLES OF THE GENUS *Dichelaspis* NEW TO INDIAN SEAS.—In my recent account of the Indian Lepadidæ (*Mem. Ind. Mus.*, vol. ii, p. 98) I described ten species of the genus *Dichelaspis* as having been obtained in the Bay of Bengal and the Arabian

Sea. Two additional species have since been taken in the Bay, namely, *D. orthogonia*, Darwin, and *D. nierstraszi*, Hoek. Both these species are fully described and figured in Hoek's account of the Cirripedia Pedunculata taken by the "Siboga" Expedition in the Malay Archipelago (1907). My specimens of *D. nierstraszi*, which through the kindness of Prof. Max Weber I have been able to compare with some of Hoek's original specimens, were found on the stem of a hydroid brought ashore in a seine-net on the beach at Puri on the Orissa coast. A single specimen of *D. orthogonia* accompanied them, while another specimen of that species was recently dredged by the "Investigator" off the coast of Burma in a depth of between 40 and 50 fathoms. Both species are common in the Malay Archipelago, and I have recently received specimens of *D. orthogonia* from Mr. J. J. Simpson, who took them on the coast of Portuguese East Africa.

N. ANNANDALE,
Superintendent, Ind. Mus.

MOLLUSCA.

NOTE ON SLUGS FROM THE EASTERN HIMALAYAS.—As a result of a recent visit to Kurseong, situated at an altitude of 4,700—5,000 feet in the Darjiling district, the following notes were made. My visit took place in the latter fortnight of June, during the rainy weather usual at that time of year.

Austenia sikkimense var. *mainwaringi*, G. A.

I found this form common on the leaves of shrubs in the jungle in the morning and evening. The colour of the living animal, which measured 25 mm. in length when fully extended, was almost black with a faint marbling on the shell lobes and occasionally with a thin brownish line on the right edge of the right shell lobe; the sole slate-grey. The visceral hump was very distinctly separated from the foot behind and appeared laterally angulate when viewed from the right side. The fresh shell was whitish and opaque at the apex, glassy and faintly tinged with brown elsewhere. The foot behind the visceral hump was relatively longer than it is in specimens preserved in spirit.

Austenia annandalei, G. A.

Godwin-Austen, *Mol. Ind.*, vol. ii, pt. xi, p. 288, pl. 128, figs. 15, 15a; pl. 130, figs. 1—1d (1910).

Two specimens of this species, which is probably by no means scarce, were obtained. One was found with its tentacles retracted, adhering tightly to a garden wall in a shady place during the day, the other was crawling in a ditch by the side of the road at dusk.

The latter was brought, the day after its capture, to Calcutta alive, but died in the act of ovipositing on the day of its arrival. Thirteen eggs were produced, but more were contained in the oviduct. They were covered with a pure white translucent membranous shell clothed with a mucilaginous coat and were ovoid or pear-shaped, the narrower end bearing a short filament in the position of a stalk. When laid each egg had a large depression on one side, but the concavity disappeared in formalin and the egg became turgid and plump. In this condition it measured, without the terminal filament, 6 mm. \times 5 mm.

The shape of the living animal when in a state of repose is well shown in the accompanying figure. The upper tentacles were long and slender and the shell was almost entirely concealed. The



Austenia annandalei in the act of oviposition, $\times \frac{2}{3}$; with single egg, $\times 2$.

colour was a dark slate-grey more or less distinctly marbled with black, the shell lobe sometimes having a brownish tinge; the sole was paler grey than the upper surface and the edge of the foot was marked vertically with white; the tip of the tentacles was white. The colour of the shell was different in the two specimens, being brownish in one (as in the type), but distinctly greenish in the other.

Cryptaustenia succinea (Rve.).

This species was common in roadside ditches during the fall of rain. The animal was of a whitish colour, which darkened on the shell lobes and the tip of the foot to grey.

N. ANNANDALE,
Superintendent, Ind. Mus.



XXII. NOTES AND DESCRIPTIONS OF INDIAN MICRO-LEPIDOPTERA.

By E. MEYRICK, B.A., F.R.S.

The specimens on which the following notes and descriptions are based were submitted to me by the authorities of the Indian Museum, and the types of the new species are in the collection of the Museum, but cotypes of the majority are also in my own collection.

PTEROPHORIDAE.

Oxyptilus praedator, n. sp.

♂. 12 mm. Head and thorax dark fuscous, metathorax and undersurface white. Palpi slender, curved, acute, dark fuscous mixed with whitish. Abdomen dark fuscous, white beneath, except towards apex. Forewings cleft from $\frac{2}{3}$, segments moderate, second dilated posteriorly, termen of first sinuate, of second concave; bronzy-blackish; some very undefined light suffusion towards base of first segment, and a faint whitish-fuscous subterminal line on both segments: cilia whitish, with two blackish patches on termen of each segment, dark fuscous on posterior half of both segments above and beneath, with two black scale-teeth on dorsum in middle and before cleft. Hindwings blackish, third segment very short and slender; cilia rather dark grey with rosy reflections, on dorsum of third segment with a very small black scale-tooth close before apex.

Sukna, E. Himalayas, 500 feet, in July (Annandale); one specimen. Apparently nearest to *O. vaughani* from Ceylon, but that species has a broad white band on basal portion of abdomen.

Platyptilia gonodactyla, Schiff.

Darjiling, E. Himalayas, 7,000 feet, in August (Paiva); two specimens, apparently in no respect different from European. I have it also from Rawalpindi.

PHALONIADAE.

Phalonia manniana, F.R.

Bosondhur, Khulna district, Ganges delta, at light, in August (Jenkins); I have it also commonly from Ceylon. There is some individual variability, but no constant difference from the European form; it is a very wide-ranging insect.

TORTRICIDAE.

Peronea divisana, Walk.

Phagu, Simla Hills, 9,000 feet in May (Annandale).

EUCOSMIDAE.

Eucosma balanoptycha, n. sp.

♂ ♀. 12-14 mm. Head and thorax grey or brownish, thorax more or less irrorated with dark fuscous. Palpi moderate, porrected. Abdomen dark fuscous. Forewings elongate, costal gently arched, in ♂ without fold, apex obtuse, termen abruptly sinuate-indentured beneath apex, then rounded, somewhat oblique; dark grey, sprinkled with whitish specks; costa marked with groups of very fine oblique alternate whitish and dark fuscous strigulae; a trapezoidal blotch of whitish irroration on dorsum beyond middle; a more or less marked dark stria from middle of costa to tornus, angulated in middle, where it forms a small spot; upper end of ocellus indicated by some whitish suffusion edged by an irregular black line, between which and costa is a subterminal series of short black marks; a round dark fuscous apical spot edged with whitish: cilia grey sprinkled with blackish and whitish. Hindwings with 3 and 4 stalked; dark fuscous, darker posteriorly; longitudinal hyaline patches in and beneath cell towards base; in ♂ beneath an elongate subdorsal glandular patch of dense dark fuscous scales, extending from near base to tornus, and an elongate blackish dorsal patch alongside; cilia fuscous, darker toward base, tips whitish-tinged.

Puri, Orissa coast, in October (Annandale); Konkan, Bombay (Young); Maskeliya, Ceylon, in June (Alston); three specimens.

Argyroploce illepida, Butl.

(*Teras illepida*, Butl., Trans. Ent. Soc., Lond., 1882, 42; *Arotrophora ombrodelta*, Low., Proc. Linn. Soc., N. S. Wales, 1898, 48; *Cryptophlebia carpophaga*, Wals., Ind. Mus. Not., iv, 106, pl. vii, 1; *Cryptophlebia illepida*, Wals., Faun. Haw. i, 681, pl. x, 23-25.)

Calcutta, bred from litchi fruit in June, and at light in August (Annandale). Having obtained a series of the Hawaiian form, I find it is identical with Australian, Indian, and South African examples; the larva feeds in various fruits.

Argyroploce aprobola, Meyr.

Puri, Orissa, in October; Quilon, Travancore, in November (Annandale). This widely distributed insect is doubtless attached to some garden tree or plant.

Argyroploce citharistis, Meyr.

Quilon, Travancore, in November (Annandale).

Laspeyresia jaculatrix, n. sp.

♂ ♀. 10-11 mm. Head and thorax rather dark fuscous. Palpi whitish, sprinkled with light fuscous. Abdomen dark grey, segmental margins whitish-sprinkled. Forewings elongate, slightly dilated posteriorly, costa gently arched, apex obtuse, termen slightly rounded, rather oblique; rather dark fuscous, tips of scales whitish; costa marked with groups of two or three very fine oblique whitish strigulae; a median dorsal patch of four slightly curved rather oblique whitish strigae, not reaching half across wing; two angulated purplish-leadene transverse striae posteriorly, of which the lower halves margin the ocellus, containing four or five short fine black dashes: cilia whitish-fuscous, with two dark fuscous shades. Hindwings dark fuscous, towards base whitish and thinly scaled; cilia whitish, with dark fuscous sub-basal line.

Calcutta (Annandale); Pusa, Bengal, bred from beneath bark of *Dalbergia sisso*, in February, May, and June (Lefroy); nine specimens.

AEGERIADAE.

Oligophlebia amalleuta, n. sp.

♂. 12 mm. Head and thorax dark shining prismatic-bronze. Palpi short, white. Antennae dark bronzy-fuscous, simple. Abdomen short, dark fuscous, segmental margins of 1, 2, and 5 partially white, apex white, beneath white. Legs dark purplish-fuscous ringed with white, middle and posterior pairs with whorls of long projecting bristles at middle and apex of tibiae, and at apex of two basal joints of tarsi. Forewings very narrow, dilated towards apex, costa sinuate, apex obtuse, termen obliquely rounded; purple-blackish; six whitish interneural streaks beyond cell, not reaching termen: cilia grey. Hindwings hyaline; veins blackish; a blackish terminal line; cilia grey.

Paresnath, W. Bengal, 4,000 feet, in April (Annandale); one specimen.

GELECHIADAE.

Epithectis oschophora, n. sp.

♂ ♀. 8-10 mm. Head and thorax fuscous, face whitish, crown sometimes suffused with whitish. Palpi whitish, second joint with several whorls of greyish scales with black bases, terminal joint with two blackish rings. Abdomen grey, apex whitish. Forewings lanceolate, acute-pointed; 9 out of 6; brownish, more or less irrorated with dark fuscous; stigmata cloudy, dark fuscous, plical obliquely before first discal: cilia greyish, with scattered black scales towards base. Hindwings grey; cilia light grey.

Calcutta and Purneah district, Bengal (Paiva); Maskeliya (Pole), Diyatalawa (Fletcher), Ceylon; from March to August, seven specimens. An inconspicuous insect.

Epitheatia telifera, n. sp.

♂ 13 mm. Head, antennae, and thorax whitish. Palpi whitish, second joint externally with a dark fuscous streak. Forewings elongate, narrow, costa slightly arched, apex acute, termen slightly sinuate, very oblique; whitish, with some scattered fuscous and dark fuscous specks; a line of blackish irroration along fold from $\frac{1}{4}$ of wing to beyond middle; a similar line from middle of disc to apex: cilia whitish, at apex with a black basal mark and two dark fuscous lines, on costa with a fuscous basal line. Hindwings and cilia grey-whitish.

Darjiling, 6,000 feet, in September, at light (Brunetti); one specimen.

Anacamptis nerteria, Meyr.

Calcutta, in September, at light (Paiva).

Timyra toxastis, Meyr.

Tenmalai, W. Ghats, Travancore, in November (Annandale).

Timyra dipsalea, Meyr.

Katihar, Purneah district, N. Bengal, in October (Paiva). The female (not previously described) differs from the male in having the palpi simple, and hindwings wholly fuscous.

Lecithocera itrinea, Meyr.

Tenmalai, W. Ghats, Travancore, in November (Annandale).

Lecithocera triophthalma, n. sp.

♂. 11 mm. Head and thorax purplish-fuscous, sides of crown tinged with ochreous-yellowish. Palpi dark fuscous, extreme apex of second joint pale ochreous. Antennae rather dark fuscous. Abdomen grey, anal tuft pale ochreous. Forewings elongate, rather narrow, costa gently arched, apex obtuse, termen nearly straight, rather strongly oblique; 2 and 3 stalked, 7 and 8 stalked; rather dark fuscous, somewhat mixed with whitish-ochreous; stigmata represented by round blackish spots edged with whitish-ochreous, plical beneath first discal; an indistinct whitish-ochreous subterminal line, indented beneath costa, forming a wedgeshaped inwardly oblique mark on costa; cilia fuscous, base barred with whitish-ochreous. Hindwings pale fuscous; cilia pale fuscous tinged with yellowish.

Tenmalai, W. Ghats, Travancore, in November (Annandale); one specimen.

Heliangara macaritis, n. sp.

♂ ♀. 13-14 mm. Head and palpi bright deep orange. Antennae dark fuscous, base orange. Thorax deep shining coppery-purple. Abdomen dark grey. Forewings elongate, rather narrow, costa slightly arched, apex obtuse, termen very obliquely rounded; bright deep coppery-purple: cilia concolorous. Hindwings and cilia dark fuscous.

Goalbathan, E. Bengal, in July (Hodgart); Konkan, Bombay (Young); two specimens. Nearly allied to *H. lampetis*, but distinguished by the dark antennae, and absence of yellow dorsal patch of forewings.

Onebala agnatella, Walk.

Trivandrum, Travancore, in November (Annandale).

Brachmia gradata, n. sp.

♂ ♀. 9-10 mm. Head and thorax ochreous-bronze. Palpi bronzy-whitish, terminal joint with a dark fuscous line. Abdomen light fuscous, and tuft ochreous-whitish. Forewings elongate, rather narrow, costa slightly arched, somewhat sinuate in middle, apex obtuse, termen rather strongly sinuate, oblique; 2 and 3 short-stalked, 8 and 9 out of 7; dark fuscous; a whitish streak above middle from $\frac{1}{3}$ to $\frac{3}{4}$, surmounted by an ochreous-yellowish streak extending to beyond it; three oblique white streaks from anterior half of costa, first two running into the yellowish streak, third to beyond its apex; a white oblique striga from costa close beyond this; an ochreous-yellow line from apex of discal streak very obliquely inwards to fold; an undefined irregular streak or line of pale ochreous suffusion beneath fold; an oval whitish ring beneath middle of disc, and a patch of whitish irroration beyond this; three short white strigulae from costa posteriorly; terminal area ochreous-yellowish, cut by a straight transverse leaden-metallic line rising from last costal strigula; adjoining this line is a small well-marked black spot anteriorly towards dorsum, and another in middle posteriorly reaching termen beneath apex: cilia ochreous-whitish, on costa dark fuscous, with a white basal line, and forming an apical projection, on termen bronzy-shining, with a metallic-grey basal shade, beneath apex with a dark fuscous patch beyond this. Hindwings grey; cilia ochreous-grey-whitish, with a grey subbasal shade.

Kurseong, 5,000 feet, E. Himalayas, in September (Annandale); Khasi Hills, in August and September, common; fifteen specimens. Belongs to a group of closely allied species, requiring attention to details; a characteristic point of this species is the arrangement of the two black spots adjoining the metallic sub-terminal line.

Brachmia elephantopa, n. sp.

♂ ♀. 16-21 mm. Head and thorax dark slaty-fuscous, crown sprinkled, with pale specks. Palpi whitish-ochreous, second joint externally dark fuscous, except towards apex, terminal joint somewhat longer than second, towards apex usually with a few dark fuscous scales. Antennae dark fuscous in ♂ simple. Abdomen fuscous, anal tuft in ♂ whitish-ochreous. Posterior tibiae fuscous. Forewings elongate, rather narrow, posteriorly slightly dilated, costa slightly arched, apex obtuse, termen obliquely rounded; 2 and 3 stalked, 7 and 8 stalked, 9 connate with 7; dark slaty-fuscous; stigmata cloudy, black, plical beneath first discal, both often more or less elongate: cilia dark fuscous, tips lighter. Hindwings and cilia fuscous.

Bhogaon, Purneah district, N. Bengal, in March (Paiva); Konkan, Bombay (Young); Coorg, 3,500 feet, in September (Newcome); Nilgiris, 3,500 feet, in March, April, and August (Andrewes); twenty specimens.

Brachmia sigillatrix, n. sp.

♂ ♀. 11-12 mm. Head, palpi, and thorax deep ochreous-yellow, partially tinged with brownish. Antennae grey, ciliations in ♂ 1. Abdomen pale whitish-ochreous. Posterior tibiae whitish-ochreous. Forewings elongate, rather narrow, costa gently arched, apex obtuse, termen nearly straight, oblique; 2 and 3 stalked, 7 and 8 stalked, 9 connate with 7; deep ochreous-yellow, irregularly mixed with light brown suffusion; stigmata black edged with white, plical obliquely before first discal: cilia ochreous-yellow. Hindwings and cilia ochreous-whitish.

Ernakulam, Cochin State, Malabar coast, in November (Annan-dale); Karwar, Kanara, in August (Maxwell); three specimens.

Brachmia autonoma, Meyr.

Ernakulam, Cochin State, Malabar coast, in November (Annan-dale); Bhogaon, Purneah district, N. Bengal, in September and October (Paiva). I described this originally from the Chagos Islands, but expressed the anticipation that it would be found in India.

Trichotaphe planata, n. sp.

♀. 18 mm. Head and thorax pale greyish-ochreous tinged with flesh-colour. Palpi ochreous-whitish, second joint dark fuscous, except apex, scales roughly expanded above towards apex, terminal joint longer than second. Abdomen whitish-ochreous. Forewings elongate, rather narrow, costa gently arched, apex round-pointed, termen sinuate, oblique; 9 out of 7; light greyish-ochreous tinged with flesh-colour; costal edge ochreous-whitish; stigmata dark fuscous, discal nearly approximated, plical obliquely before first discal: cilia ochreous-whitish partially suffused with

pale brownish, with traces of darker bars. Hindwings with 6 and 7 approximated towards base; grey; cilia light grey.

Dharampur, Simla Hills, 5,000 feet, in May (Annandale); one specimen.

Nothris malacodes, Meyr.

Trivandrum, Travancore, at light, in November (Annandale).

Ypsolophus ianthes, Meyr.

Quilon and Shencottah, Travancore, in November (Annandale).

Ypsolophus decusellus, Walk.

Calcutta, in September (Annandale); one example, yellower than usual.

COSMOPTERYGIDAE.

Cosmopteryx asiatica, Stt.

Museum compound, Calcutta, in July (Annandale).

Cosmopteryx basilisca, Meyr.

Sukna, E. Himalayas, 500 feet, in July (Annandale).

Cosmopteryx hamifera, Meyr.

Sukna, E. Himalayas, 500 feet, in July (Annandale).

Stathmopoda anconias, n. sp.

♂ ♀. 10-11 mm. Head and thorax dark shining bronze, face whitish-bronzy. Palpi ochreous-whitish, terminal joint more or less suffused with dark fuscous. Abdomen dark fuscous, segmental margins purple-grey edged anteriorly with coppery, on sides white. Tibiae with whorls of long bristles at origin of spurs. Forewings lanceolate, widest at $\frac{1}{3}$, thence narrowed to acute apex; dark purple-bronze, sometimes with indigo-greenish reflections; base narrowly blackish; a rather narrow orange-yellow fascia at $\frac{1}{3}$, strongly edged with black; an orange-yellow elongate longitudinal mark in disc about $\frac{2}{3}$, preceded and followed by black suffusion reaching costa, connected anteriorly with a shorter orange-yellow mark on termen; a small white costal spot or mark above posterior extremity of this, sometimes confluent with it: cilia fuscous. Hindwings dark fuscous; cilia fuscous.

Puri, Orissa, in October (Annandale); Pusa, Bengal, in December (Lefroy); Peradeniya, in February (Green); Trincomali, in June (Fletcher), Ceylon.

OECOPHORIDAE.

Scythris expolita, n. sp.

♂ ♀. 11 mm. Head, palpi, antennae and thorax dark fuscous-bronze, palpi moderately long, rising above vertex; antennal ciliations in ♂ $\frac{3}{4}$. Abdomen rather dark fuscous, beneath with last four segments and half preceding one suffused with whitish-ochreous, in ♂ somewhat less strongly. Forewings lanceolate, acute, venation normal; shining dark bronzy-fuscous, hardly perceptibly purplish-tinged towards apex: cilia concolorous. Hindwings $\frac{1}{2}$, cilia 3; 5 absent; rather dark fuscous: cilia fuscous.

Kurseong, E. Himalayas, 5,000 feet, in July (Annandale); Ukhral, Manipur, 6,400 feet, in August (Pettigrew); two specimens.

Endrosis lactcella, Schiff.

Kurseong, E. Himalayas, 5,000 feet, in July (Annandale); Darjiling, 7,000 feet, in August (Paiva).

Borkhausenia pseudospretella, Stt.

Darjiling, 7,000 feet, in August (Paiva).

Periacma (?) *mnemonica*, n. sp.

♀. 13-14 mm. Head, palpi, and thorax dark purplish-fuscous. Abdomen rather dark fuscous. Forewings elongate, costa gently arched, apex obtuse, termen rounded, rather strongly oblique; 7 to costa; dark purplish-fuscous; a large pale whitish-ochreous oblique transverse blotch rather before middle, reaching costa but not dorsum; a small cloudy ochreous-whitish spot on costa before $\frac{3}{4}$: cilia dark purplish-fuscous. Hindwings dark bronzy-fuscous; cilia bronzy-fuscous.

Kurseong, E. Himalayas, 5,000 feet, in September (Annandale); Khasi Hills, in August; two specimens. In the absence of the ♂ the generic position is not fully assured, but is probably correct.

Cryptolechia stomota, n. sp.

♂ ♀. 11-12 mm. Head pale ochreous or whitish-ochreous, sometimes somewhat marked with fuscous suffusion. Palpi whitish-ochreous, second joint with appressed scales, sprinkled with blackish, terminal joint with blackish median band. Antennae whitish-ochreous ringed with dark fuscous. Thorax pale ochreous somewhat sprinkled with dark fuscous, shoulders dark fuscous. Abdomen greyish, anal tuft of ♂ whitish-ochreous. Forewings elongate, narrow, costa gently arched, apex round-pointed, termen extremely obliquely rounded; 7 to costa; pale ochreous sprinkled with dark fuscous; a dark fuscous blotch on base of costa; stigmata dark fuscous, plical obliquely before first discal; a semioval

dark fuscous blotch on costa somewhat beyond middle; a triangular dark fuscous tornal spot, and a dark fuscous apical blotch, sometimes confluent on termen: cilia dark fuscous. Hindwings grey; cilia pale grey.

Kurseong, E. Himalayas, 5,000 feet, in September (Annandale); Khasi Hills, from August to October; Coorg, 3,500 feet, in May and September (Newcome); Nilgiris, 3,500 feet, in August (Andrewes); Matale, Ceylon, in August (Pole); eleven specimens.

ELACHISTIDAE.

Elachista ithygramma, n. sp.

♂ ♀. 7-8 mm. Head ochreous, sides broadly whitish. Palpi whitish, second joint with several whorls of pale ochreous whitish-tipped scales. Thorax ochreous, with two white stripes, lateral margin of patagia white. Abdomen grey, on sides and beneath ochreous-whitish. Forewings lanceolate, acute; ochreous, with four white longitudinal streaks, more or less sprinkled throughout with grey; first streak along costa from $\frac{1}{3}$ to apex, second from base above middle to or near termen beneath apex, third along fold throughout, fourth along dorsum and termen throughout; an indistinct small blackish dot between second and third towards termen; a few blackish scales at apex: cilia whitish-ochreous, base ochreous, round apex sprinkled with dark grey points towards base. Hindwings grey; cilia pale whitish-ochreous tinged with grey.

Quilon, Travancore coast, in November (Annandale); four specimens. Apparently allied to *E. thallophora* from New Zealand.

Elachista nearcha, n. sp.

♂ ♀. 8-9 mm. Head, palpi, and thorax white, palpi shorter and straighter than usual. Abdomen light grey, segmental margins whitish. Forewings lanceolate, acute; white; plical stigma represented by a thick elongate black mark, second discal by a short fine black dash; an oblique fascia of brownish irroration crossing wing before second discal stigma, and a less marked inwardly oblique fascia from costal extremity of this across plical stigma to dorsum; a more or less developed apical patch of brownish irroration: cilia white, round apex sprinkled with brownish towards base, and with a median line of dark fuscous points. Hindwings rather dark grey; cilia pale grey.

Puri, Orissa, in October, at light (Annandale); Calcutta, in April; two specimens.

SCHENDYLOTIS, n. g.

Head smooth; ocelli present; tongue developed. Antennae $\frac{3}{4}$, basal joint moderately elongate, without pecten. Labial palpi moderate, slender, smooth-scaled, slightly curved, porrected,

terminal joint shorter than second, acute. Maxillary palpi obsolete. Posterior tibiae smooth-scaled, with whorls of expanded bristles at origin of spurs. Forewings with 2 from towards angle, 4 absent, 7 and 8 stalked, 7 to costa, 9 and 10 from near angle, 11 absent. Hindwings $\frac{2}{3}$, lanceolate, cilia 4; transverse vein absent between 4 and 5, 5 and 6 stalked.

I denuded the undersurface of one pair of wings of the unique specimen, and satisfactorily ascertained the neururation.

Schendylotis chrysota, n. sp.

♀ . 7 mm. Head, palpi, and thorax blackish, patagia golden-metallic. Forewings lanceolate, acute; bronzy-blackish; a triangular golden-metallic spot on base of dorsum, not reaching costa; golden-metallic fasciae at $\frac{1}{3}$ and $\frac{3}{4}$, furcate on dorsum, white on costa, with violet reflections in disc; a white discal dot between these: cilia dark fuscous, with a golden-metallic basal streak on termen. Hindwings and cilia dark fuscous.

Kurseong, E. Himalayas, 5,000 feet, in September (Annandale); one specimen.

GLYPHIPTERYGIDAE.

Phycodes minor, Moore.

Rajmahal, Bengal, in July (Annandale).

Simacthis orthogona, Meyr.

Rajmahal, Bengal, in July (Annandale).

Simacthis fabriciana, L.

Simla, 7,000 feet, in May (Annandale).

Brenthia elatella, Walk.

Puri, Orissa, in October (Annandale).

GRACILARIADAE.

Lithocolletis conformis, n. sp.

♂ ♀ . 6-7 mm. Head pale ochreous. Thorax bronzy-ochreous sprinkled with whitish. Abdomen dark grey. Forewings lanceolate; bronzy-orange-ochreous, sometimes tinged with fuscous; a short fine indistinct whitish median basal dash; two slightly curved narrow shining white rather inwardly oblique transverse fasciae at $\frac{1}{4}$ and $\frac{1}{2}$, anteriorly blackish-edged, slightly approximated towards costa, second sometimes slightly angulated in disc; a similar fascia at $\frac{3}{4}$, interrupted in middle; an inwardly oblique

short silvery-whitish mark from costa before apex, edged with some blackish scales: cilia greyish or greyish-ochreous, with two or three rows of blackish points. Hindwings and cilia grey.

Kasauli, Simla Hills, 6,300 feet, in May (Annandale); three specimens.

Epicephala bromias, n. sp.

♀. 7 mm. Head ochreous-whitish on crown, frontal hairs dark grey beneath, face white. Palpi white, second and terminal joints each with extreme apex and a median dot black. Antennae white ringed with dark fuscous. Abdomen dark grey. Forewings elongate, very narrow, moderately pointed; dark fuscous; a light fuscous streak along dorsum from base to tornus, upper edged suffused with white, thrice indented, and margined by a black plical streak; a whitish streak partially suffused with light fuscous extending on costa from $\frac{1}{3}$ to middle and thence running as a slender line to above tornus, edged anteriorly with blackish suffusion; an angulated white line from $\frac{3}{4}$ of costa to tornus, nearly preceded on upper half by a fuscous line edged anteriorly with blackish suffusion, its apex angulated backwards above extremity of preceding line from costa; a short black mark along termen, edged above with white, apical area above this streaked with blackish: cilia light fuscous mixed with whitish, round apex with two or three rows of black points. Hindwings dark grey; cilia grey.

Calcutta, in May (Annandale); one specimen.

Epicephala albifrons, Stt.

Calcutta and Purneah district, Bengal; W. Ghats, Travancore; in October and November (Annandale).

Acrocercops convoluta, Meyr.

Parasnath, W. Bengal, 4,300 feet, in April (Annandale); Kurseong, E. Himalayas, 5,000 feet, in September (Annandale).

Gracilaria octopunctata, Turn.

Darjiling, 7,000 feet, in August (Paiva).

Gracilaria scansoria, n. sp.

♂. 10 mm. Head and thorax lilac-ochreous sprinkled with dark fuscous. Palpi pale ochreous, suffused with blackish towards apex of second joint, and on terminal joint, except towards base. Antennae whitish ringed with dark fuscous. Abdomen grey, anal tuft whitish-ochreous. Anterior and middle femora and tibiae blackish. tarsi white with black dots at apex of joints, posterior legs whitish. Forewings very narrowly elongate, moderately

pointed; pale brownish-ochreous irrorated with dark fuscous, slightly lilac-tinged; costa and dorsum shortly strigulated with blackish irroration; a pale brassy-yellowish spot on costa at $\frac{1}{3}$ reaching half across wing, anterior edge convex, well-defined, posterior edge suffused: cilia grey, round apex pale ochreous with several dark fuscous lines. Hindwings rather dark grey; cilia grey.

Phagu, Simla Hills, 9,000 feet, in May (Annandale); one specimen.

PLUTELLIDAE.

Epermenia chelyodes, n. sp.

♂ ♀. 8-11 mm. Head, palpi, and thorax white. Abdomen whitish. Forewings elongate-lanceolate, acute; 7 and 8 stalked; white, with scattered blackish scales; two undefined oblique patches of pale ochreous suffusion from dorsum near base and before middle, marked with black scales on dorsum; more or less irregular pale ochreous suffusion towards middle of disc, sometimes forming a defined patch beyond middle; a small blackish spot on middle of costa; apical third variably more or less suffused with blackish irroration, including a roundish pale ochreous patch anteriorly: cilia grey, on costa and at apex mixed with blackish, beneath apex and at tornus with whitish base, on dorsum whitish with three small blackish scale-teeth. Hindwings dark grey; cilia whitish, on apical half of termen grey, above apex with a dark grey patch.

Kurseong, E. Himalayas, 5,000 feet, in July (Annandale); Khasi Hills, in September and October; Palni Hills, 6,000 feet (Campbell); five specimens.

Zelleria petrias, Meyr.

Simla, 7,000 feet, in May (Annandale).

Yponomeuta temulentus, n. sp.

♂. 12 mm. Head and thorax dark grey suffused with reddish-brown. Palpi dark fuscous. Forewings elongate, rather narrow, costa gently arched, apex obtuse, termen rounded, oblique; 7 and 8 stalked; dark grey, strewn throughout with small undefined suffused black spots, veins partially suffused with red-brown; an irregular white patch in disc about $\frac{1}{4}$; an irregular white spot on costa beyond middle; some scattered white scales in disc; an irregular transverse white mark from tornus reaching half across wing; an irregular white terminal streak running round apex: cilia red-brown, base sprinkled with white. Hindwings dark fuscous; cilia reddish-fuscous.

Theog, Simla Hills, 8,000 feet, in May (Annandale); one specimen.

Arcrolepia nitrodes, n. sp.

♂. 11 mm. Head and thorax brownish mixed with black. Palpi brownish, suffusedly banded with dark fuscous irroration. Antennae fuscous ringed with black. Abdomen grey. Forewings elongate, narrow, costa anteriorly moderately, posteriorly slightly arched, apex round-pointed, termen almost straight, very oblique; light brownish, with a faint violet tinge, irregularly mixed and strigulated with black; costa marked with longer black strigulae; a dorsal patch of three white strigulae before middle; a whitish line from $\frac{2}{3}$ of costa to tornus, margined anteriorly by a blackish-fuscous patch on upper half; three white strigulae from costa between this and apex; a small blackish spot towards termen in middle: cilia whitish-grey, with two blackish-grey lines. Hindwings ovate-lanceolate, pale grey, suffused with dark grey towards termen and apex; cilia grey.

Parasnath, W. Bengal, 4,300 feet, in April (Annandale); one specimen. Allied to the European *pygmaeana*, but I have a Ceylon species still more like the European form, though certainly distinct.

Plutella maculipennis, Curt.

Purneah district and Rajmahal (Annandale), Bengal.

TINEIDAE.

Nepticula oritis, n. sp.

♂. 5 mm. Head and eyecaps pale whitish-yellow, antennae and thorax dark leaden-fuscous. Abdomen dark fuscous. Forewings lanceolate; blackish; a rather broad little oblique shining white fascia beyond middle: cilia grey. Hindwings and cilia grey.

Phagu, Simla Hills, 9,000 feet, in May (Annandale); one specimen, in fine condition.

Orostega chalcophylla, n. sp.

♂ ♀. 7-10 mm. Head and eyecaps shining whitish, sometimes ochreous-tinged, antennae ochreous-grey. Thorax shining bronze. Abdomen dark grey. Forewings rather broad-lanceolate; shining bronze, with greenish or purplish reflections, variable in depth of colouring: cilia pale bronzy-ochreous. Hindwings and cilia grey or dark grey.

Kurseong, E. Himalayas, 5,000 feet, in September (Annandale); Khasi Hills; six specimens.

CLADARODES, n. g.

Head smooth, with rough frontal tuft; ocelli present; tongue absent. Antennae $\frac{5}{6}$, in ♂ simple, basal joint dilated into a large oblong eyecap. Labial palpi moderate, filiform, drooping. Maxillary palpi rather long, several-jointed, filiform. Posterior tibiae

with series of bristles above. Forewings with 3 absent, 4 absent, 7 and 8 stalked, 7 to costa, 11 from middle. Hindwings under $\frac{1}{2}$, linear, cilia 6; 3 absent, 4 absent, 6 absent.

Differs from *Lyonetia* mainly by the well-developed maxillary palpi.

Cladarodes peloptera, n. sp.

♂. 7-8 mm. Head pale greyish-ochreous, face ochreous-whitish. Palpi and antennae whitish. Thorax greyish-ochreous. Abdomen grey-whitish. Forewings narrowly lanceolate, acute; glossy greyish-ochreous, with a purplish tinge: cilia pale greyish-ochreous. Hindwings grey; cilia whitish-grey.

Calcutta, at light, in June (Paiva); N. Coorg, 3,500 feet, in September (Newcome); three specimens.

Opogona chalinota, n. sp.

♂ ♀. 7-10 mm. Crown and thorax dark bronzy-fuscous, fillet, face, and antennae ochreous-white. Palpi ochreous-white, second joint with a dark fuscous streak externally on upper half from base to near apex. Abdomen dark fuscous. Forewings lanceolate; dark fuscous-bronze; a white line crossing wing about $\frac{2}{3}$; a whitish-ochreous apical spot: cilia fuscous, round apex whitish-ochreous. Hindwings dark grey; cilia grey.

Puri, Orissa coast, in October (Annandale); Pusa, Bengal, bred in March from larvae feeding in dry stems of *Polypodium quercifolium* (Lefroy); Colombo, Ceylon, in August (Green); five specimens.

Opogona percnodes, n. sp.

♂ ♀. 12-15 mm. Head, thorax, and abdomen dark purplish-fuscous, fillet and face shining pale whitish-ochreous. Palpi ochreous-whitish, externally dark fuscous. Antennae fuscous, beneath whitish-ochreous. Forewings lanceolate, acute; glossy dark fuscous, with purplish-bronzy reflections: cilia dark fuscous. Hindwings dark fuscous, faintly purplish-tinged; cilia dark fuscous.

Kurseong, E. Himalayas, 5,000 feet, from July to September (Paiva); Maskeliya, in May (Pole), Diyatalawa, in August (Fletcher), Ceylon; eight specimens.

Opogona flavofasciata, Stt.

Calcutta, in June and September (Paiva).

Ereunetis xenica, Meyr.

Calcutta, at light, in August (Annandale).

Monopis sertifera, n. sp.

♂ ♀. 12-13 mm. Head and thorax yellow, palpi, patagia, and abdomen dark fuscous. Forewings elongate, rather narrow,

costa moderately arched, apex obtuse, termen somewhat rounded, oblique; 9 and 10 short-stalked; dark purplish-fuscous mixed with blackish, strewn with small leaden-bluish dots; a suffused round subhyaline spot in middle of disc; an irregular bright yellow streak along dorsum from base to tornus, edge emarginate beneath discal spot; a bright yellow blotch beyond discal spot, almost reaching costa; an irregular bright yellow apical spot extending along upper half of termen, more or less produced anteriorly into irregular streaks on lower part of wing; all these yellow markings are more or less edged with ferruginous suffusion: cilia bright yellow, on costa dark fuscous, except towards apex. Hindwings bronzy-grey; cilia whitish-grey.

Kurseong, E. Himalayas, 5,000 feet, in September (Annandale); Khasi Hills; four specimens.

Monopis dicycla, Meyr.

Bred from larvae destroying woollen cloth, Calcutta, in September (Annandale).

Tinea fuscipunctella, Haw.

Kurseong, 5,000 feet, in July (Annandale); Dharampur, Simla Hills, 5,000 feet, in May (Annandale).

Tinea pachyspila, Meyr.

Trivandrum, Travancore, in November (Annandale).

Tinea nestoria, n. sp.

♂. 17-19 mm. Head and antennae yellowish-white. Palpi dark fuscous. Thorax rather dark purplish-fuscous. Abdomen pale brassy-ochreous. Forewings elongate, costa moderately arched, apex round-pointed, termen very obliquely rounded; pale greyish-ochreous, more or less tinged and sprinkled with fuscous; base suffused with dark fuscous, extending as a narrow streak along costa to $\frac{2}{3}$; a small undefined spot of dark fuscous suffusion on end of cell: cilia light ochreous, sometimes tinged with fuscous, more whitish towards tips. Hindwings grey, with brassy-yellowish and purplish reflections; cilia grey-whitish, sometimes infuscated towards base.

Phagu, Simla Hills, 9,000 feet, in May (Annandale); Dalhousie, Kashmir, in May; two specimens.

Pylactis mimosae, Stt.

Calcutta, at light, in July (Annandale). I have now ascertained that *seminivora*, Wals., and *ophionota*, Meyr., are both synonyms of this.

TROPHIMAEA, n. g.

Head loosely rough-haired; ocelli present; tongue absent. Antennae $\frac{1}{2}$, in σ moderately ciliated, basal joint clothed with long dense hairs projecting in front in a broad tuft. Labial palpi moderate, porrected, clothed with long rough projecting scales beneath, second joint with several projecting lateral bristles. Maxillary palpi obsolete. Posterior tibiae clothed with long hairs. Forewings with 1b furcate, 2 rather remote from angle, 3 and 4 connate from angle or 4 absent, 7 absent, 9 absent, 11 from or beyond middle. Hindwings $\frac{3}{4}$, ovate-lanceolate, cilia $1\frac{1}{2}$; 2-7 separate, parallel, or 4 and transverse vein between 3 and 6 sometimes absent.

Trophimaea arenatella, Walk.

Kurseong, E. Himalayas, 5,000 feet, in September (Annandale).

Sapheneutis crocotricha, n. sp.

σ . 14-17 mm. Head with tolerably appressed scales, ochreous-yellow, face sometimes mixed with fuscous. Palpi short, loosely scaled, yellowish mixed or suffused with dark fuscous. Antennal ciliations 2. Thorax and abdomen dark fuscous. Forewings elongate, moderate, costa moderately arched, apex obtuse, termen somewhat rounded, oblique; 8 and 9 stalked; purplish-fuscous, suffusedly and indistinctly strigulated with darker fuscous, veins and costa darker-suffused: cilia purplish-fuscous, sometimes with pale greyish-ochreous basal line. Hindwings rather dark fuscous, purplish-tinged; cilia light ochreous-fuscous, basal half suffused with purplish-fuscous.

Kurseong, E. Himalayas, 5,000 feet, in July (Annandale); N. Coorg, 3,500 feet, in November (Newcome); two specimens.

XXIII. ON SOME AQUATIC OLIGOCHAETE
WORMS COMMENSAL IN *SPONGILLA*
CARTERI.

By J. STEPHENSON, M.B., D.Sc. (Lond.).

I recently received from Dr. Annandale, of the Indian Museum, a specimen of a form of *Spongilla carteri*, Bwk., taken at Bheemanagar, Travancore, and sent by the authorities of the Trivandrum Museum to Calcutta. The specimen was stated to contain a number of aquatic Oligochaeta, and it was these which I undertook to examine.

The worms were found to be very numerous; they could be obtained in numbers by teasing any small fragment of the sponge, and could be picked out from the disintegrated portions of the sponge at the bottom of the bottle.

Thirty-eight specimens taken at random were prepared and mounted for microscopic examination; some were mounted unstained in glycerin and potash, some unstained and some stained in balsam. A first inspection showed that there was one specimen of *Pristina longiseta*, Ehrbg., and that all the rest belonged to the genus *Nais*.

As was to be expected, a certain number of the specimens were distorted in shape, and others had their dorsal setae entirely or almost entirely broken off. The rest were classified under the high power into three groups, as follows:—

- (i) Forms without eyes, with obviously forked needles in the dorsal bundles.
- (ii) Forms without eyes, with dorsal needles showing only a very fine forking, or in which forking was not evident.
- (iii) Forms with eyes.

All the individuals of groups (ii) and (iii), and a number of those of group (i) (which were the most numerous), were submitted to detailed examination with the oil immersion lens.

As is well known, the usual mode of reproduction in the Naididae is the asexual, by fission. Sexual reproduction seems, in the majority of forms, to take place only at certain seasons of the year, and is comparatively rare; consequently the sexual organs have as yet been described only in a minority of the forms included in this family. It can hardly be doubted that descriptions of these organs, if they could be obtained, would give very great help in the task of discriminating the various species.

Signs of asexual multiplication were found frequently enough in the present specimens. There were no chains of two or more still unseparated animals; but a number of the individuals examined had evidently been recently separated, as shown by the blunt or square, sometimes obviously lacerated prostomium, and the small size of the ventral setae of segments ii—v; these last, it may be said, are new productions in the zone of budding, and hence are when first developed smaller than those of the segments posterior to them.

But unfortunately none of the specimens examined in the present instance showed any sign of sexual organs; and it is necessary therefore to fall back on other structures, and specially on the characters of the setae, in order to find marks capable of being used for purposes of diagnosis. As a matter of fact the current diagnoses of the known species of this and many other genera of the family are still based very largely on the setae; and the following accounts, though necessarily incomplete, have therefore the merit of affording a possibility of comparison with previously described forms.

The association between the worms and the sponge may be called a commensalism. A similar phenomenon has been recorded by Annandale (*Journ. and Proc. As. Soc. Bengal*, N.S., Vol. II, No. 5, 1906), who found a *Chaetogaster* (*C. spongillae*) living in association with *Spongilla carteri* in Calcutta; in this case the commensal was only found in those parts of the sponge which had been killed or were dying, the healthy growing parts being quite free from them; Annandale accordingly supposes that it feeds on the organic débris left by the decay of the sponge. This supposition appears to be not improbable, since *Chaetogaster* is carnivorous,—exclusively carnivorous as far as I have observed the genus, I think; though Annandale (*Journ. and Proc. As. Soc. Bengal*, N.S., Vol. I, No. 4, 1905) speaks of having received from England a specimen in which the food probably consisted of diatoms and the like. The advantage to the *Chaetogaster* of a copious food-supply is obvious; there may also (Annandale, *l.c.*) be an advantage to the sponge in the liberation of the gemmules by the worm.

So far as I have observed, however, the other genera of the Naididae are pure vegetable feeders, and hence the advantage which the forms now under discussion receive from association with the sponge would appear to be rather that of protection; whether the advantage is altogether on their side, or whether they contribute anything in return, I am unable to say.

Of the species of *Nais* described below, one (*N. pectinata*) is undoubtedly new; but with regard to the others the question is not so simple. The form with eyes resembles very closely that described by me (*Memoirs Ind. Mus.*, Vol. I, No. 3) as *Nais variabilis*, Piguet, var. *punjabensis*. At the time when I described this form, however, I had not studied the genital apparatus; nor had Dr. Piguet published his account of the genital organs in

N. variabilis. These gaps have since been filled up (Piguet, *Rev. Suisse de Zool.*, Tome 17, Fasc. 1, 1909; Stephenson, *Rec. Ind. Mus.*, Vol. V, part 1); and Dr. Piguet, who has himself examined specimens of both forms, has (*loc. cit.*, p. 200) come to the conclusion that my worm should be called *N. communis*; Piguet, var. *punjabensis*. I accept Piguet's conclusion, and shall, therefore, refer to the form in what follows under this latter name.

The remaining specimens have no eyes, but here again there is an almost complete agreement in the characters of the setae with the last form and with the Punjab variety of *N. communis*. The question then is whether the presence or absence of eyes is of itself of specific value; and this point, as will be seen below, I have decided in the negative, giving this form varietal rank only, as var. *caeca*. I may add that *Nais bretscheri* is also described as having or as wanting eyes.

It is, however, noteworthy that specimens with well developed eyes and others in which they are completely absent should be found in such close association. It is at first sight tempting to suppose that, as in so many cases throughout the animal kingdom, so here, the exposure to light stimulates pigment formation and a life in darkness suppresses it; the eyes of the Naididae are mere pigment spots, and hence on this supposition it would be those specimens which inhabited the superficial parts of the sponge which developed eyes, and those which lived in its deeper parts which failed to do so. It seems to me rather doubtful, however, whether the conditions in an ordinary mass of *Spongilla carteri* would be so different at the surface and in the interior; and also whether the worms are so entirely sedentary as would be implied on this hypothesis.

I have added, for purposes of comparison, a description of the setae of what I regard as a typical specimen of *N. communis*, var. *punjabensis*, from Shalimar Gardens near Lahore, which I examined during the course of the present investigation in order to satisfy myself of the amount of similarity or difference between these several forms.

Pristina longiseta, Ehrbg.

One specimen only was seen. This was an extremely well marked example; the 'proboscis' measured .175 mm. in length, while one of the characteristic elongated dorsal setae of the third segment was over half a millimetre (.54 mm.) in length, and thus reached far beyond the extremity of the proboscis.

It seems doubtful whether this animal could have been living within the sponge. The enormously elongated setae just mentioned could there have had no free play; they would have much impeded the animal's movements, and would probably very soon have been broken off. The fact that only one example out of thirty-eight was of this species is also, I think, significant. This one specimen was not improbably merely crawling on the surface of the sponge at the time it was taken.

Nais pectinata, sp. nov.

The greater number of specimens belong to this species; they are those which were at first separated from the rest by the obvious forking of the dorsal needles.

On examination with the oil immersion lens, however, I was surprised to find that these setae had an entirely different form from what I had supposed. Instead of being simply forked, they were in all cases ctenate, the two prongs at the sides being the strongest, and the interval between them being filled in by a number of extremely fine points, two, three, four, or five in number. It was these intermediate points which had not been detected with the ordinary high power (Zeiss DD, oc. 6); with this degree of magnification the outermost prongs are alone visible, and hence the setae appear to be bifurcate at their extremity. It is not always possible to count accurately the intermediate prongs even with $\frac{1}{12}$ in. oil immersion and compens. oc. 6, and recourse to a 12 oc. is sometimes necessary.

Such a form of dorsal needle has not hitherto been described in the genus; so far as I know, indeed, this type of seta has not previously been met with in the family, and the nearest approach would seem to be the fan-shaped dorsal needles of *Dero tonkinensis*, Veld. It would therefore appear to be a character of quite sufficient importance to justify the erection of a new species.

The description of the animal is as follows:—

Length of single individual (preserved specimen) about 2 mm. *Prostomium* well marked, conical with rounded tip. No eyes. *Segments* 27—31.

The *buccal cavity*, in segment ii, is narrow and tubular; the pharynx, which succeeds it, extends from segment iii to iv.

The *cerebral ganglion* appears to be deeply bifid both in front and behind; it is broader from side to side anteriorly than posteriorly.

The *ventral setae* are of the usual type, and are differentiated into two groups, those of segments ii—v, and those posterior to these.

Those of segments ii—v are regularly 3 per bundle, are about $56\ \mu$ in length, and have a markedly thinner shaft, with its proximal portion less strongly curved than those of the posterior segments. The distal prong is $1\frac{1}{4}$ times as long as the proximal, but this latter is the thicker, — $1\frac{1}{2}$ to twice as thick as the former at its base; both prongs are slightly swollen near their bases. The nodulus is proximal to the middle of the shaft, the relations of the distal and proximal portions of the shaft being 4 : 3; the swelling of the nodulus is equal on both sides of the shaft (fig. 1a).

The posterior ventral setae are sometimes 2, often 3, not unfrequently 4, and occasionally 5 per bundle. In length they are 51 — $56\ \mu$, the latter, longer measurement being that of setae towards the hinder end of the body. The shaft is thicker, and its

curve proximal to the nodulus is more marked, than in the anterior group of setae. The distal and proximal prongs of the fork are equal in length, the proximal being 2 or $2\frac{1}{2}$ times as thick at its base as the distal, and both having a slight swelling near their base. The nodulus is equal on both sides of the shaft, and is situated distal to the middle in the proportion proximal : distal :: 5 : 4. (Pl. xi, fig. 1b).

The *dorsal setae* are regularly arranged in bundles of one hair- and one needle-seta. On one occasion a bundle of three was seen, composed of two needles and one hair. They begin in segment vi. The *hairs* are smooth, in length nearly or quite equal to the diameter of the body. The *needles* have a length of $56\ \mu$; the shaft is straight except in its distal third, where it is slightly sickle-shaped; the end is ctenate, the outer prongs on each side are the strongest, the intermediate prongs are fine, and 2, 3, 4 or 5 in number; some irregular forms were seen (fig. 1 d.e.f.). The nodulus is rather a slight angle in the shaft than a distinct swelling; it occurs at the junction of middle and distal thirds (fig. 1c).

Nais communis, Piguët, var. *punjabensis*.

Three specimens were observed.

In length they were about 2 mm. *Segments* of the one perfect specimen 26. The *prostomium* appeared shorter and more rounded than in the previous species, or than in perfect specimens as met with in Lahore; but I do not lay any stress on this, since this part may have been contracted in these specimens, or, which I think more probable, the individuals had only recently been separated,—perhaps separated spontaneously at the time of killing. The facts that, while the pharynx extended to segment v, the *alimentary canal* posterior to this showed no recognizable differentiation into oesophagus, stomach, and intestine; and that in one (stained) specimen the *brain* was much shorter from front to back than from side to side, I am inclined to explain in the same way,—*i.e.*, by supposing that the anterior part of the body had not yet completed its full differentiation. The *eyes* were laterally situated at the level of the mouth, were of moderate size, and of a deep purple colour; there were no 'Nebenaugen.'

The *ventral setae* of segments ii—v were $86\ \mu$ in length, the shaft thinner than in those of posterior segments, and only slightly curved. The distal prong of the fork was $1\frac{1}{2}$ times as long as the proximal, the latter, on the contrary, being $1\frac{1}{2}$ times as thick at its base. The nodulus was slightly proximal (proximal : distal :: 8 : 9); the swelling of the nodulus was slightly more marked on that side of the shaft which corresponds to the longer prong of the fork. (Fig. 2a.)

Posterior to segment v the ventral setae were 70—75 μ in length, with shaft moderately curved, and thicker than in the case of the anterior segments. The distal prong of the fork was very slender, only a little (up to $1\frac{1}{5}$) longer than the proximal, and

slightly swollen near its base; the proximal prong was more than twice as thick as the distal. The nodulus was distinctly distal to the middle (proportions varying,—proximal : distal :: 11 : 9 or 8 : 7), and was slightly more prominent on the side of the shaft corresponding to the distal prong. (Fig. 2b.)

The number of the ventral setae per bundle was either three or two throughout.

The *dorsal setae* were of two kinds, hair-setae and needles. The hair-setae were somewhat shorter than the diameter of the animal. The needles projected very little from the surface, and were in length 54—56 μ . The shaft was straight, except for a very slight curve in its distal portion; its extremity was very finely double-pointed. The nodulus was rather a slight angle on one border of the shaft than a definite swelling; it was situated at the junction of the distal and middle thirds. (Fig. 2c.)

The dorsal bundles consisted always of one hair and one needle.

Nais communis, Piguët, var. *caeca*, n. var.

These forms were more numerous than those with eyes, with which, for the rest, they closely correspond.

The *length* was about the same. *Segments* 24—27. In one example the dorsal setae began on segment v, in the rest on segment vi.

The *ventral setae* were in bundles of 2 or 3 throughout. In segments ii—v they were 80, 90, or 94 μ in length, the shaft possessing a slight double curve, and a thickness estimated as about $\frac{3}{4}$ of that of the setae in the more posterior segments. The distal prong had a slight swelling near its base, and was $1\frac{1}{4}$ times as long as the proximal, which latter was $1\frac{1}{2}$ — $1\frac{2}{3}$ as thick. The nodulus was more prominent on the side corresponding to the distal prong, and was situated proximally to the middle point of the shaft (proximal to distal 8 : 9 or 9 : 10). (Fig. 3a.)

In segments from vi onwards the length of the ventral setae was 71, 81 or 87 μ ; the shaft was thicker and more strongly curved than in the anterior segments; the distal prong equal to the proximal in length, or very slightly longer, but only half, or even less, as thick at its base. The nodulus, more prominent on the side of the distal prong, was distal to the middle, but its exact position was somewhat variable (proximal : distal :: 8 : 6, or 19 : 14, or 10 : 9). (Fig. 3b.)

The *dorsal setae* were regularly one hair-seta and one needle per bundle. The hairs were in length equal to about $\frac{3}{4}$ the diameter of the (preserved) animal's body. The needles were in length 53—58 μ , with a shaft in which a very slight double curve might or might not be recognizable. The extremity was finely bifurcate, the prongs short, equal in length, one thicker than the other at the base. The nodulus, a slight fusiform swelling, was distally situated (distal : proximal :: 4 : 13). (Fig. 3c.)

I subjoin, for purposes of comparison, a description of the

setae of a specimen of *N. communis*, var. *punjabensis*, from Shalimar, near Lahore.

Ventral setae of segments ii—v:—length $94\ \mu$, shaft not much curved, thinner than those of the more posterior segments. Distal prong half as long again as proximal, the latter being twice as thick at its base. Nodulus equal on both sides of shaft, slightly proximal (12 : 13). Four setae per bundle. (Fig. 4a.)

In segments vi and onwards:—length $84\text{--}87\ \mu$, shaft stouter and more curved than in anterior segments; distal prong $1\frac{1}{4}$ times as long as proximal, which latter is double as thick at base; nodulus equal on both sides of shaft or slightly more marked on the side of the distal prong; distal to middle (4 : 5, or, in a more posterior segment, 11 : 16). Commonly four setae per bundle, sometimes five, or three. (Fig. 4b.)

Dorsal setae in bundles of one hair- and one needle-seta; the latter $69\ \mu$ long, the shaft slightly curved beyond the nodulus in the form of a sickle, and very slightly in the reverse direction proximal to the nodulus; finely bifurcated at the extremity; nodulus distal (3 : 8). (Fig. 4c.)


I may perhaps be permitted to add a few words in regard to this form, with reference to Piguet's criticisms in his recent paper (*Rev. Suisse de Zool.*, Tome 17, Fasc. I, 1909). An examination of the reproductive organs has, as already mentioned, resulted in approximating this form to *N. communis* rather than to *N. variabilis*, to which latter, however, the setae of the Punjab variety show the greater resemblance. A renewed examination of the 'thorn-like projections' of the dorsal setae, and the facts that such projections may be present on the ventral setae also (though rarely), and that (in a *Pristina*, for example) they may cluster round the dorsal setae in such lengths and numbers as to give the seta the appearance of a miniature ostrich feather, has convinced me that Piguet is right in supposing them to be a cryptogamic growth.

With regard to Piguet's suspicion that there may have been more than one species or variety of *Nais* among the specimens which I used for my description,—and that my account of the variations in the dorsal setae may be due to this cause, I will not at present venture an opinion, since I have not yet had time for a renewed investigation. But I do not expect to be able to record any very large number of aquatic Oligochaeta from the environs of Lahore. With the exception of artificial tanks in pleasure gardens or in connection with manufactories, and the canal, the only body of water is the river Ravi. The artificial tanks, much to the detriment of zoological studies, undergo periodical cleansing,—I think much more frequently nowadays than some years ago; and the irrigation canal runs for a few days, and is then dry for a longer or shorter period,—hence it is useless in this connection. There are no natural freshwater ponds or pools except in the rains; and the months from October to June inclusive are (with

the exception of a few showers in January) rainless. It seems unlikely, therefore, that a large variety of forms should ever be discoverable in this neighbourhood.

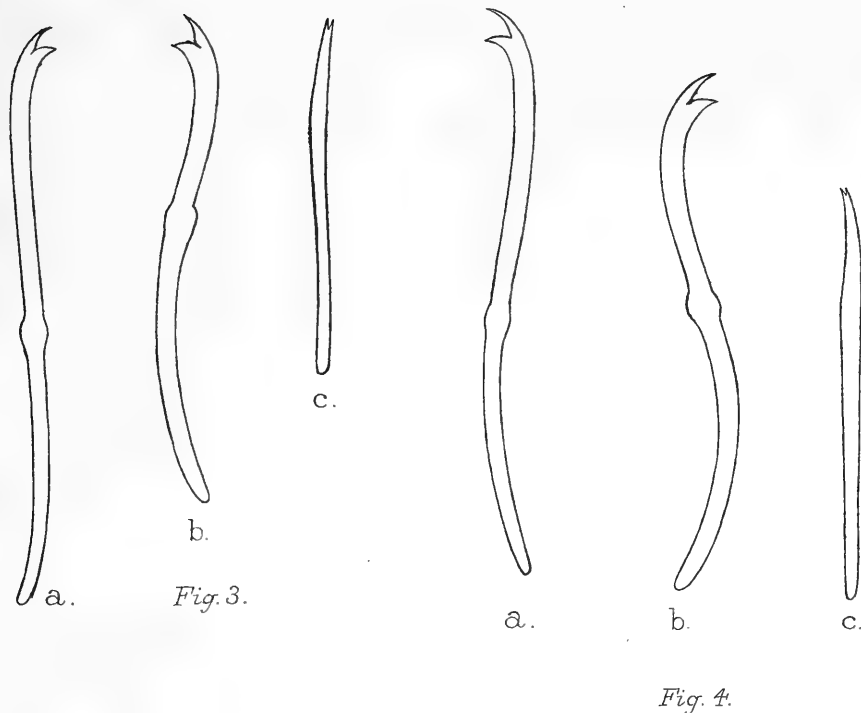
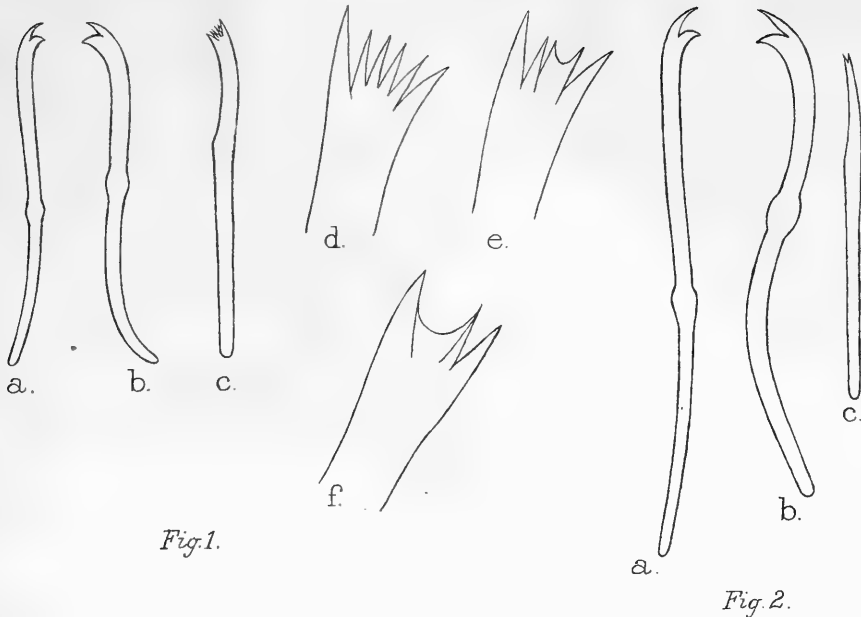
I am in complete agreement with Piguet when he says, "pour distinguer sûrement les *Nais* indiennes les unes des autres, et pour établir leur rapports avec les espèces déjà connues, il faudra étudier à fond leur appareil génital." But it is improbable that any more material from the same source as that described in the present paper will reach me, and the chances, in any case, would be against its including any sexual specimens; as Piguet says, "à moins d'une chance rare, ce n'est qu'en poursuivant ses recherches pendant des années, en toute saison et dans des milieux aquatiques aussi variés que possible, qu'on peut espérer se procurer un matériel de *Naïdées* sexuées permettant une étude un peu approfondie." It seemed better, therefore, to give the above descriptions as they stand.

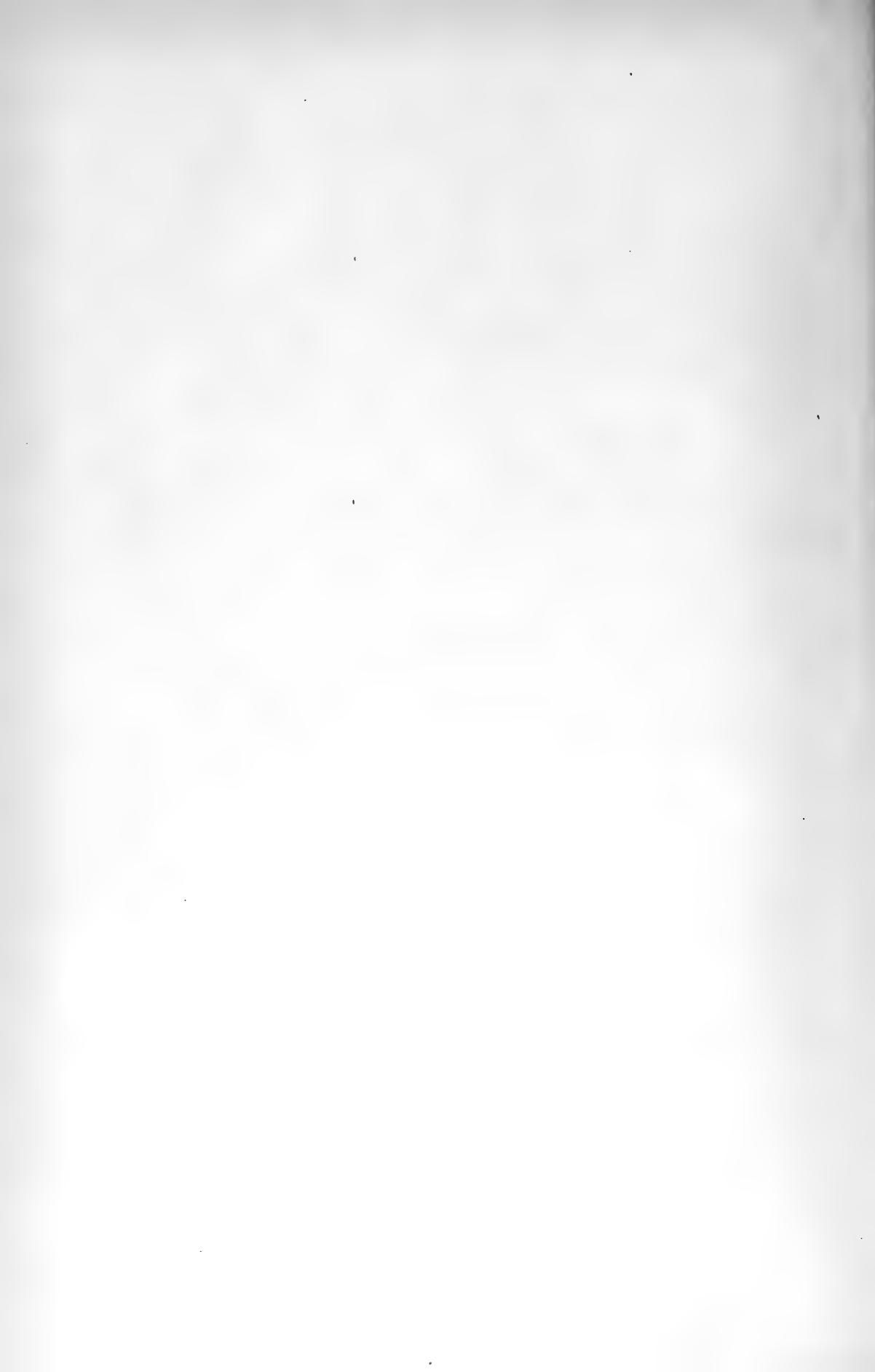
The position, briefly, is this. *Nais communis*, var. *punjabensis*, has been shown by its sexual organs to be closely related to *N. communis*; and this is expressed by making it a variety of this latter species, though its setae have, on the whole, a greater resemblance to those of *N. variabilis*. I have examined a form with eyes from Travancore, which, as far as can be ascertained, is so similar to the above mentioned variety from the Punjab that it appears mere hair-splitting to separate them. A form without eyes also occurs along with the last, identical with it, it would seem, in every other respect, so far as can be seen from an examination of the available material. If the Travancore form with eyes is a variety of *N. communis*, then so will be this latter. But these conclusions will be subject to revision in case sexual specimens become available for examination.



EXPLANATION OF PLATE XI.

- FIG. 1. *Nais pectinata*, sp. nov.
 a, Ventral seta of anterior segments (ii—v); *b*, ventral seta of posterior segments; *c*, needle-seta of dorsal bundles; *d*, *e*, *f*, irregular forms of needle-setae of dorsal bundles.
- FIG. 2. *Nais communis*, Piguët, var. *punjabensis*, from Bheemanagar, Travancore.
 a, Ventral seta of anterior segments (ii—v); *b*, ventral seta of posterior segments; *c*, needle-seta of dorsal bundles.
- FIG. 3. *Nais communis*, Piguët, var. *caeca*.
 a, Ventral seta of anterior segments (ii—v); *b*, ventral seta of posterior segments; *c*, needle-seta of dorsal bundles.
- FIG. 4. *Nais communis*, Piguët, var. *punjabensis*, from Lahore, for comparison with fig. 2.
 a, Ventral seta of anterior segments (ii—v); *b*, ventral seta of posterior segments; *c*, needle-seta of dorsal bundles.





XXIV. ON *BOTHRIONEURUM IRIS*, BEDDARD.

By J. STEPHENSON, *M.B., D.Sc. (Lond.)*.

I recently received from Dr. Annandale for examination a tube of worms which had been taken at Kurseong in the Eastern Himalayas. These I believe to be the species first described by Beddard from the Malay Peninsula, in 1901, as *Bothrioneuron iris*; Michaelsen subsequently examined some specimens of the same form from Kurseong.

These appear to be the only occasions on which this species has been met with; the material at the disposal of the investigator does not seem in either case to have been large in amount, since Beddard speaks of finding spermatophores in three out of six mature examples, and Michaelsen had one mature and a number of immature specimens at his command.

The collection sent to me from the Indian Museum comprised a considerable number of individuals, of which perhaps a third were sexual. I have been able to note a certain number of variations from the original description; and it seems worth while therefore to add the following short account to the existing literature of this form

Bothrioneurum iris, Beddard.

1901 *Bothrioneuron iris*, Beddard, *Proc. Zool. Soc. Lond.*,
1901, vol. i, p. 81.

1909 *Bothrioneurum iris*, Michaelsen, *Mem. Ind. Mus.*,
vol. i, No. 3, p. 135.

The present specimens were whitish in colour in the preserved condition; after transference to oil of cedar preparatory to examination by transparency or imbedding, the posterior half of a number of specimens was darker than the anterior, in fact was blackish.

The longest specimens measured about one inch; the worms were moderately stout. Annulation distinct. A number of epizoic Ciliata, not unlike *Spirochona* in general form, were attached to a number of individuals, perhaps to most, near their posterior end.

Segments about 64. Prostomium semicircular. The surface of all the individuals shows a number of blisters, or raised patches of epithelium, probably due to the method of fixation (Perenyi's fluid).

Setæ. Both dorsal and ventral series are of the same type, double-pronged and doubly curved in the usual \int -shape: both

begin in segment ii. Their average length is about .087 mm.; the longest measured was .094 mm. The prongs of the fork are at a wide angle to each other, the distal being usually, not always, the longer, about $1\frac{1}{2}$ times as long as the proximal; the proximal however is the thicker, $1\frac{1}{2}$ times as thick as the distal prong at its base. There is a nodulus, which is situated distal to the middle of the shaft; its exact position varies only slightly, the proportions between the length of the shaft proximal and distal to the nodulus being about as 5:3. The number of setæ per bundle varies from three to six in the anterior part of the body, and in the posterior is regularly two per bundle. There are no ventral setæ on the segment which bears the male aperture (xi or xii). An examination in balsam of the specimen with five spermatophores, referred to below, seems to show that the dorsal setæ of segment xi (that of the male aperture) are small and singly pointed.

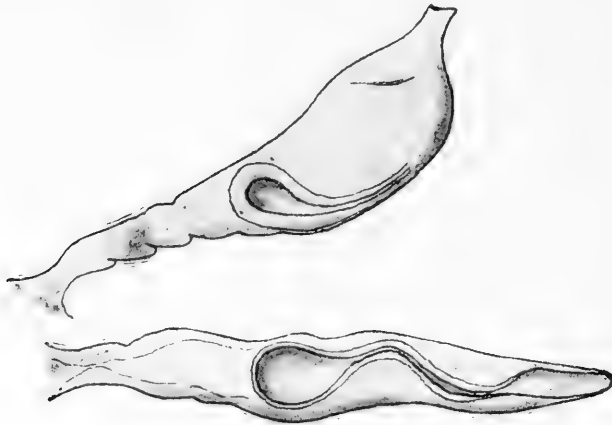


FIG. 1.—Two spermatophores from the same individual, showing their deformations when empty.

The *sensory depression* on the prostomium has the characters described by Beddard; it is variable in position, and may be nearly terminal.

The *clitellum* varies in position. It may be on segments xi and xii, or on xii and xiii.

The *male aperture*, single, median and ventral, varies in position with the clitellum; it is on xi or xii, accordingly as one or other of these is the first segment of the clitellum. In one case the clitellum extended over $\frac{1}{2}$ xi, xii, and xiii; ventral setæ were present on xi, and therefore the male pore was probably on xii, though owing to distortion at this place it could not be actually seen.

The setal distribution on these segments varies, as already said, according to the position of the male aperture, ventral setæ being always absent from the segment in which this occurs. They

appear to be sometimes absent in the following segment also ; thus in a specimen with no ventral setæ in xi, there was on one side in xii one seta only, and on the other side none ; while in another case none could be distinguished in either xi or xii.

The *spermatophores* characteristic of the genus are present on some, not all, sexual individuals. They have the general form described by Beddard ; when empty, many, indeed nearly all, exhibit a characteristic deformation (fig. 1). Such spermatophores appear at first sight to have a large pear-shaped opening on one side, the broad end of pear being towards the attached end of the spermatophore ; the margins of this apparent opening seem to be raised and rounded. The appearance is however probably due to shrinkage, since the margin of the apparent opening may not be complete at the narrow end of the pear ; moreover, one empty spermatophore had no such appearance of a lateral rent ; and in one case an open mouth was distinctly seen at the distal end of the spermatophore. The spermatozoa therefore probably escape from the free end of the spermatophore, and, as Beddard previously concluded, arguing from the solid nature of the stalk, hypodermic impregnation is improbable.

The spermatophores may occur singly, or may be present in larger numbers ; I counted as many as five in one specimen, and two on several occasions. They are found on the clitellar segments, often in or near the intersegmental groove behind the male aperture. I have never seen any on the ventral surface, *i.e.*, within the ventrolateral ridges which give this part of the body a triangular appearance in transverse section ; they are, for example, all dorsal or dorso-lateral in the specimen with five spermatophores already referred to. With one exception, all spermatophores seen were empty.

The female apertures are small openings in the intersegmental furrow behind the male aperture.

Reproductive organs. The testes spring from the junction of the septum and the ventral body-wall. The sperm funnels are small. The first part of the conducting apparatus is contained in a forward bulging of the septum on each side, so that this part of the tube is at the same actual level in the animal's body as the testis in the preceding segment, and the testis may appear wedged in between the winding vas deferens on the outer and the intestine on its inner side. The vas deferens is divisible into two regions, of which the characters and relations are as described by Beddard.

The atrium (spermiducal gland) differs a little from the previous description of *B. iris*. The typical condition, as illustrated by several series of sections, appears to be as follows :—the first part is a well defined tube, without the thick investment of peritoneal cells which clothes the vas deferens ; it is circular in transverse section and gradually widens, having on the whole a somewhat fusiform shape ; its epithelium consists of numerous layers of close-set cells, the inner ones being columnar ; the cells are very finely granular, and the cytoplasm stains equally. The next

part reaches to within a short distance of the aperture; the epithelium is columnar, the cells are in a single layer, and the lining has a ragged appearance, due to the fact that the inner portions of the cells are not in contact with each other; these cells are mucous cells, their bodies being for the most part clear

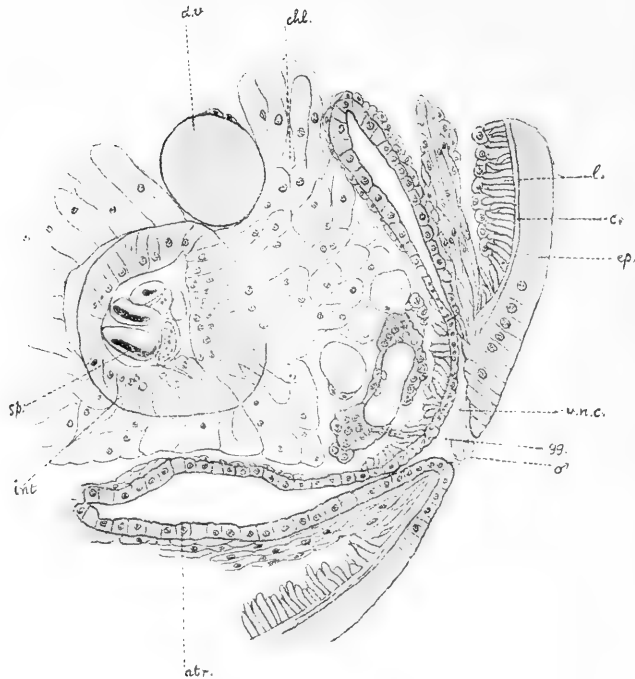


FIG. 2.—Part of a transverse section passing through the male aperture. The character of the epithelium lining the last part of the atrium, the flattening of the nerve cord in this region, its 'Neurochordröhrchen', the great bulk of the chloragogen cells, and the Sporozoa in the alimentary tract (the nucleus of one individual has broken up), are illustrated. The ventral vessel is the structure just dorsal to the nerve cord.

Zeiss's drawing apparatus, obj. DD, oc. 6.

Atr., atrium; *c.*, circular muscular layer; *chl.*, chloragogen cells; *d.v.*, dorsal vessel; *ep.*, surface epithelium; *gg.*, nerve ganglion cells; *int.*, intestine; *l.*, longitudinal muscular layer; *sp.*, sporozoa in intestine; *v.n.c.*, ventral nerve cord; σ , male aperture.

and non-staining, and masses of a clear secretion are cast out into the lumen; the walls of the tube are thinner than those of the first part, and its outline is far less regular,—not only internally, owing to the ragged nature of the lining, but externally also, since a number of small diverticula are given off from it; these diverticula are lined by a similar epithelium to that of the tube

itself. The paratrium, which is small, egg-shaped, without a cap of peritoneal cells, and possesses a hardly distinguishable lumen, arises from this portion of the tube a little beyond the end of the first part; its mouth is invaginated into the atrium. The last part of the tube, comprising only a short extent near the male aperture, is lined by a cubical or even slightly flattened epithelium (fig. 2).

I am, however, doubtful if there is any such sharp division between the character of the cells of the first and second parts of the tube as is indicated above. In one of the series of sections, the cells of the first part of the tube, as well as the second, are mucous-looking cells, in appearance very similar to those of the clitellum in the same specimen; and the cells of the second part of the tube are close-set like those of the first part, and not ragged in appearance. The differences may, therefore, be due to differences in the functional activity of the cells.

The ovaries are in the segment succeeding the testes. The female apertures have already been mentioned. The egg funnels, in the only specimen in which they were identified, are small, and the oviducts short and narrow. There are no spermathecae.

With regard to the other systems, the following remarks may be made. The *alimentary canal* shows very little differentiation from mouth to anus; in segment i what may be called the buccal cavity is lined by a flattish epithelium; this is succeeded by columnar cells in segment ii; in segments ii and iii the cells are higher than elsewhere, and this portion may be called the pharynx; a few muscular fibres radiate backwards in these segments, attaching the pharynx to the bodywall, and reaching the parietes in segments iii and iv. Masses of gland cells are present in connection with the alimentary canal in segments iii, iv and v. Two of the most striking features in sections are the enormous parasitization of the anterior part of the alimentary canal by large sporozoa, and the great bulk of the chloragogen cells around the alimentary tube; these latter begin in segment iv (*cf.* fig. 2).

I have, in agreement with Beddard, failed to find any system of *cutaneous capillaries*. The atria unite in the middle line underneath the *nerve cord*, as described by that author; the nerve cord is here very considerably flattened in a horizontal direction; it contains, in the anterior part of the body, a tubular cavity (*Neurochordröhrchen*), which is double in the genital region, and may be so elsewhere (fig. 2).

The original diagnosis of *B. iris*, as given by Beddard, runs as follows:—Male pore single and median on xii. Clitellum xii, xiii. No integumental vascular system. No genital setae. Spermatophores present to the number of one.

It will be seen that the present specimens do not conform to this diagnosis, since (i) the male pore is not invariably on xii; (ii) nor is the clitellum invariably on xii—xiii; and (iii) the spermatophores may be as many as five. Further differences are found in (iv)

the number of setæ in a bundle,—not more than four in Beddard's specimens, sometimes as many as six in mine ; (v) the position of the spermatophores,—not round the male generative pore, but on the dorsal and dorsolateral surfaces of the clitellar segments ; (vi) some histological differences in the male efferent apparatus.

It may therefore seem hazardous to include these specimens in the same species with those formerly described. I do so however for the following reasons :—

(a) The species is already known to be a variable one. This is illustrated by the variations in the position of the sensory depression on the head. It is also illustrated by the fact that in the single specimen recently examined by Michaelsen, which he had no difficulty in assigning to this species, the male aperture was on the xi, and the clitellum on the xi and xii segments ; and it is interesting to note that Michaelsen's words, " I think this dislocation (*i.e.*, the dislocation backwards of male organs and clitellum in Beddard's specimens) an abnormality without systematic importance," are supported by the finding of both modes of disposition in the one batch of specimens examined by me. And further, the variable nature of this form comes out in the difference in shape of the spermatophores as found by Beddard and Michaelsen respectively.

(b) As noted above, the number of specimens at the disposal of previous investigators appears to have been small. It is therefore not impossible that the examination of a larger number of individuals would have revealed variations similar to those recorded in the present paper, which would have necessitated a widening of the specific diagnosis.

(c) I have of course also been influenced by the fact that my specimens come from Kurseong,—the identical place from which those submitted to Prof. Michaelsen were taken.

I have in conclusion to offer my thanks to Dr. Annandale for affording me the opportunity of examining this interesting form.

XXV. NOTES ON NUDIBRANCHS FROM THE INDIAN MUSEUM.

By SIR CHARLES ELIOT, K.C.M.G., F.Z.S., Vice-Chancellor
of the University of Sheffield.

The following notes deal with some nudibranchs kindly sent to me for examination by Dr. N. Annandale, Superintendent of the Indian Museum, Calcutta. Many of the specimens are of some age and so discoloured and distorted that it hardly seems profitable to describe them. They indicate, however, that the genus *Pleurophyllidia* (or *Linguella*) is abundant in Indian waters. The specimens noticed here are in good condition, and the characters of the new species appear to be certain. Both these species are connecting links which bridge over the differences dividing recognized genera, and indicate, like so many nudibranchs discovered in the last decade, that these genera have been too rigidly defined.

The collection also contains specimens which, though in a poor state of preservation, appear to belong to *Pleurobranchæa morula*, Bergh. This form also is of interest as a connecting link, for though it has most of the characters of *Pleurobranchæa*, the dorsal parts are clearly separate from the foot and overhang it, much as in *Pleurobranchus*.

The species described below are:—

1. *Linguella quadrilateralis*, Bergh.
2. *Cuthona annandalei*, sp. nov.
3. *Thordisa annulata*, sp. nov.
4. *Doris* (*Staurodoris*) *pustulata*, Abraham.
5. *Chromodoris albo-pustulata* (?), Pease.

Linguella quadrilateralis, Bergh.

See Bergh; Anat. Unters. af *Sancara quadrilateralis*, *Naturh. Tidsskr.*, 1863, pp. 484—538, and Malac. Unter. in Sempers Reisen, Heft vi, pp. 266—268.

Two specimens from the Audamans, the largest 39 mm. long and 14 mm. broad. The shape is squarish and clear-cut. The ground colour in both is brownish green, marked in one with light longitudinal lines, and in the other with small white spots, arranged in fairly regular rows. This variation between stripes or ridges and spots or tubercles arranged in rows is found in other Phyllidiidæ. The rhinophores are whitish with green perfoliations. The lateral lamellæ are whitish and about 30 on either side: in the

branchial cleft are about 25 white lamellæ. There is no caruncle but a few projections in front of the rhinophores.

The jaws are rather long and narrow with about 8 rows of denticles, which are especially plain on the masticatory process. The formula of the radula is about $30 \times 40 + 1 + 1 + 1 + 40$. The broad and high central tooth bears about 5 ridges and denticles on either side, and six more on the median cusp. The first tooth is low, bearing about 5 denticles on both sides. The other teeth bear about 8 denticles, decreasing in number outwards until there are only one or two. The nine outermost teeth or so are smooth.

Judging by the dentition, this appears to be the *Linguella* (*Sancara*) *quadrilateralis* of Bergh. According to his descriptions the number of denticles on the laterals varies from 32 to 8, which is an unusually wide range. But perhaps the former figure is a misprint.

The colour appears to be better preserved in these specimens than in those previously described, and it seems probable that the living animal is greenish with white dots, sometimes united into longitudinal lines.

Cuthona annandalei, sp. nov. (Plate xix.)

Three specimens were found on stones at Port Canning on the Mutlah River in the Sunderbunds. A coloured drawing was made of one while still alive, and all three were examined by me in the Calcutta Museum when they had not been long in spirits. They are 70—80 mm. long and 50—70 mm. broad, including the cerata, but were probably about 1.50 mm. long when living and extended. The colours, as far as preserved, agree with the drawing.

The head is expanded into a roundish disk bearing two nearly equal pairs of simple tentacles with no trace of perfoliation. The eyes are small, but distinct and black. The foot is not angulate, but, like the head, is expanded into a disk. The tail is short and rounded.

The purplish diverticula of the liver are visible through the skin. They communicate with a distinct purple hepatic tract in the body cavity posterior to the stomach. The branches of this tract are simple and clear, as in *Tergipes*. The cerata are disposed in two divisions. The first consists of four groups lying immediately behind the rhinophores¹ and supplied from the right and left diverticula of the stomach. Then comes a gap, and behind it are 6-7 rows of cerata, the rows on the right and left hand sides not being accurately opposite to one another. There are 5-6 cerata in each row, and all are supplied from the posterior diverti-

¹ It would appear from the figure that this is not the case in the living animal, but due to contraction.

culum of the stomach. The cerata are cylindrical and moderately tapering. In the preserved specimens the swelling below the tip is less marked than in the figure (fig. 2).

The jaws are yellowish and bear a single row of distinct denticles, which have blunt, but not square, tips. In the specimen dissected the radula consists of a single row of 40 teeth, white, transparent, and in some respects resembling the type found in the genus *Aeolidiella*. There is a single, low, central cusp, and on either side of it 10—15 (rarely more) long, pointed denticles. The basal part of the tooth (fig. 3) is large and squarish, not thin and crescent-shaped as in *Aeolidiella*.

The verge is conical, and appears to terminate in a small curved process which may be a chitinous tube.

The animals spawned in captivity. The egg ribbon is white, and consists of a single simple coil.

A first view of the radula of this animal suggests that it should be referred to *Aeolidiella*, but when the teeth are separated and the broad bases become visible, the resemblance to this genus is less striking. Also in *Aeolidiella* the jaws are not denticulate. It is better, on the whole, to refer the present specimens to the group of animals described under the names of *Cratena*, *Hervia*, *Amphorina*, *Cuthona*. Its dentition is not unlike that of *Cratena bylgia*, but the number of teeth and of denticles on the teeth is larger. I have discussed the nomenclature of these forms (which have been unnecessarily subdivided into many genera) in the Journal of the Marine Biological Association, vii, 1906, pp. 363—366, and think that the present specimens should be called *Cuthona*. It is doubtful, in my opinion, if this genus is really separable from *Amphorina*, but that genus has usually a tapering radula, a peculiarity not found in the radula here examined.

In any case this species shows how the dentition of *Aeolidiella* may have developed out of that of *Cuthona*.

[The specimens for which this species has been founded were obtained in the Matlah River, a brackish tidal creek, at a distance of about sixty miles from the open sea. This is, I believe, the nearest approach to a freshwater locality from which Nudibranchs have yet been recorded. A sample of water taken from the Matlah at Port Canning for analysis not more than a fortnight later three years ago was found to contain 25.46 parts of soluble salts per thousand (see *Rec., Ind. Mus.*, vol. i, p. 36). The molluscs were found among some stones that have been deposited a few hundred yards below the town of Port Canning in shallow water near the left bank of the river. These stones are partially uncovered at low tide. The banks of the river are entirely composed of the dense mud that forms so persistent a feature of the Gangetic delta. The food of these Nudibranchs probably consisted of a Hydroid (? *Bimeria vestita*), with which they were associated on the stones.—F. H. GRAVELY.]

Thordisa annulata, sp. nov.

One specimen from the Andamans. It is much bent, but about 25 mm. long and 14 mm. broad. The general colour of the dorsal surface is yellowish white, diversified with strongly contrasting brown rings. The general texture is soft, and the whole dorsal surface is covered with soft papillæ, about 1 mm. high in the central area and smaller near the edges. The openings for the rhinophores and branchiæ are also surrounded by small papillæ. A certain number of dorsal papillæ have their bases enclosed by perfect or imperfect brown rings. The rest are colourless. These rings are more numerous and more regular at the sides of the visceral mass, where they form two lines on either side. They are also numerous at the anterior and posterior ends of the mantle margin. But in the mid-dorsal space they are faint and imperfectly formed. On the underside of the mantle are a few scattered deep brown spots. The branchiæ are six, tripinnate and greyish. The anterior portion of the foot is contracted, but appears to be grooved and notched. The tentacles are represented by two roundish lumps.

There is no labial armature. The radula is crowded and rather confused, but the formula is about $35 \times 50.0.50$. Most of the teeth are hamate, rather tall and thin, decreasing towards the centre, the first six or so on either side of the rhachis being quite low with long bases. At the outer ends of the rows the last five teeth are small, very transparent, and difficult to see. Often they are merely jagged or serrulate, but in some rows, at any rate, the last three teeth bear a tuft of fine hairlike denticles.

The stomach is small and lies wholly outside the liver. The œsophagus and intestine are disposed so as to form an apparent circle. The liver is of a deep chocolate-brown, but its whole surface is covered by the white hermaphrodite gland, which is deeply channeled in many places and not even.

The genitalia were rather hardened, and few details could be ascertained, but it was clear that the verge is provided with a very large and striking armature, consisting of scales bearing conical spines of considerable size as in *Platydoris*. Near the tip there are two rows of these scales only. On the lower part of the verge (and perhaps in the vas deferens) there are as many as twelve rows, but the spines are not quite so large and rather elongate.

It is not easy to fix the genus of this form, for it combines (1) rings, like those found in *Diaulula sandiegensis*, (2) pectinate marginal teeth, as in *Thordisa*, (3) a genital armature, as in *Gargamella*. I call it *Thordisa*, simply because that is the oldest of the three genera (1877), and the most likely to survive as a name, if as a result of further investigation several of Bergh's genera are amalgamated.

Doris (Staurodoris) pustulata, Abraham.

See Abraham, *Proc., Zool. Soc.*, 1877, p. 205: Basedow and Hedley, *Trans., Roy. Soc., S. Australia*, xxix, 1905, p. 151.

One specimen from the Andamans. About 60 mm. long and 23 mm. broad—colour yellowish. The branchiæ are grey and darker than the rest of the body.

Over the dorsal surface are scattered large flat warts or knobs of various sizes, and the rims of the branchial and rhinophorial pockets are protected by special tubercles. The foot is grooved: the tentacles appear to be represented by a lump on either side of the head.

There is no regular labial armature, but the labial cuticle bears a granulate stripe, which, if a little more developed, would be called a ring of short rods. The formula of the radula is about $40 \times 55.0.55$, but many of the rows are incomplete. The teeth are simply hamate and erect. The innermost and outermost are smaller, but not denticulate or degraded.

No armature was found in the genitalia.

This specimen appears to be the *D. pustulosa* of Abraham, of which Basedow and Hedley have given a coloured figure. It seems referable to Bergh's genus *Staurodoris*, but, as I have pointed out elsewhere, if the type of that genus is the *D. verrucosa* of Linnæus, then the genus ought to be called *Doris*, and *Staurodoris* can be retained as at most a subgeneric designation.

Chromodoris albo-pustulosa (?), Pease.

See Pease, *Proc. Zool. Soc.*, 1860, p. 30.

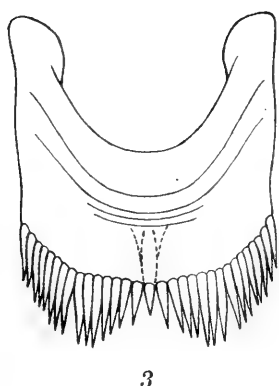
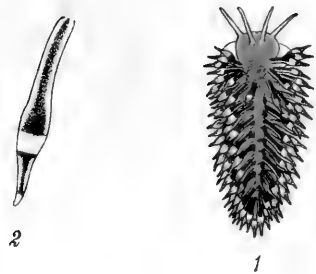
One specimen from the Andaman Islands, 15 mm. long and 5 mm. broad. It is white with traces of a darker border. The tubercles are yellowish. They are fairly numerous on the dorsal surface, especially in the middle, and there are also several in front of the rhinophores. They are flattish, about 1 mm. in breadth and .5 mm. in height. The rhinophorial and branchial pockets are not raised and are not tuberculate. The branchiæ are small and slender, 11 in number, and greyish in colour, with a white stripe on the outside of the rhachis. The tentacles are inverted. On the underside of the posterior mantle margin are eight spherical glands.

The labial armature is distinct and greyish. It consist of rods swollen at the tip and bifid. The formula of the radula is about $100 \times 40.0.40$. When looked at as a whole, it gives an impression of a great number of long denticles. The teeth are bifid with two strong prongs at the tip and 4—6 large, clear-cut denticles below

them. The three teeth nearest to the rhachis on either side are broader than the others, and the first bears at least 4 denticles on the innerside.

Several Chromodorids bearing tubercles or prominences on the back have been described, but the present specimen does not agree completely with any of them. I do not think its identification with *Chr. scabriuscula*, *verrucosa*, *nodulosa*, *pantherina*, *pustulans* or *papulosa* is justifiable, and as its appearance in life is unknown, and the other characters are not very remarkable, it seems unwise to make it the type of a new species. It is possibly the *Chr. albo-pustulosa*, which was imperfectly described by Pease, without any account of the dentition.





CUTHONA ANNANDALEI sp. nov.

XXVI. ON THE CLASSIFICATION OF THE POTAMONIDÆ (TELPHUSIDÆ).

By A. ALCOCK, C.I.E., F.R.S.

Since working at the Indian Potamonidæ, I have been able, thanks to the kindness of Dr. W. T. Calman, to look through the British Museum non-Indian Collection of these crabs, and this paper is an attempt at a synthesis of the family from data thus obtained. I say "an attempt," because a synthesis implies a complete analysis, and such an analysis in the case of the Potamonidæ involves an actual examination of every species that has been described. My justification for making the attempt is that the matter has an important bearing upon theories of geographical distribution.

Ortmann (Zool. Jahrb., Syst. x, 1897, p. 297) divides the Potamonidæ into four subfamilies, namely: (1) POTAMONINÆ, to include, *Potamon*, *Acanthotelphusa*, *Potamonantes*, *Geotelphusa*, *Paratelphusa* and *Erimetopus*; (2) DECKENIINÆ, for the unique genus *Deckenia*; (3) POTAMOCARCININÆ, to include *Potamocarcinus*, *Epilobocera*, *Hypolobocera* and *Kingsleya*; and (4) TRICHODACTYLINÆ, with *Trichodactylus* and *Orthostoma* as constituents.

Miss Rathbun (Nouvelles Archives du Mus. d'Hist. Nat., ser. 4, vi, 1904, pp. 245—247) divides the Potamonidæ into five subfamilies, namely: (1) POTAMONINÆ, embracing *Potamon*, *Potamonantes*, *Paratelphusa*, *Peritelphusa*, *Geotelphusa*, *Hydotelphusa* *Platytelphusa* (= *Limnotelphusa*) and *Erimetopus*; (2) PSEUDOTELPHUSINÆ, for *Pseudotelphusa*, *Potamocarcinus*, *Epilobocera* and *Rathbunia*; (3) TRICHODACTYLINÆ, for *Trichodactylus*, *Dilocarcinus* and *Valdivia*; (4) GECARCINUCINÆ, for *Gecarcinucus*; and (5) DECKENIINÆ, for *Deckenia*.

Both these systems emphasize the following points:—

(1) The isolation of the African Deckeniinæ. As I know only one of the three species (*D. imitatrix*) of the genus, I can hardly criticise this opinion further than to say that if *D. imitatrix* had come into my hands as an unknown form, I should have been inclined to regard it as a peculiarly modified *Acanthotelphusa*.

(2) The segregation of the American Trichodactylinæ. With this opinion I entirely agree. If a specimen of *Trichodactylus fluviatilis* had been brought to me as an unknown form, without any information as to its freshwater habitat, I doubt whether I should have referred it to the Potamonidæ at all.

(3) The disjunction of the American Potamocarcininæ or Pseudotelphusinæ. To this opinion I can give only a hesitating

assent. *Potamocarcinus* and its relatives seem to me to fall in with my series of *Paratelphusinæ* or *Gecarcinucinae*, though they certainly have some common peculiarities of their own.

(4) The close relation of *Potamon* and *Paratelphusa*. In my memoir of the Indian Potamonidæ I have given the reasons against this association.

In Dr. Ortmann's scheme *Acanthotelphusa* is recognised as a distinct subgenus closely related to *Erimetopus*. This is, I am sure, a natural arrangement; but nothing supports Dr. Ortmann's conjecture that *Acanthotelphusa* has any specially close relation to *Potamocarcinus*.

In Miss Rathbun's scheme *Gecarcinucus* is certainly quite out of perspective. This genus, so far from being anything extraordinary, can with difficulty be dissevered from *Paratelphusa*.

For my own part I should like to eject the *Trichodactylinae* and to see *Deckenia* subordinated to the *Potamoninae*, and *Potamocarcinus* and its relatives subordinated to the *Paratelphusinæ*, leaving only two subfamilies of *Potamonidæ*; but at the present moment I only propose to re-arrange Miss Rathbun's scheme slightly, and to re-characterize some of her subfamilies, as exhibited in the following synopsis and key:—

SYNOPSIS OF SUBFAMILIES OF POTAMONIDÆ.

- | | | | |
|---|---|---|------------------|
| 1 | { | Dactyli of crawling-legs not spinose:
merus of external maxillipeds elongate, its outer border being longer than that of the ischium measured from the fork of the exopodite. Mandibular palp of three distinct joints, its terminal joint simple. Abdomen of male broadly triangular, the 6th segment when separate being several times broader than long | TRICHODACTYLINÆ. |
| | | Dactyli of crawling-legs spinose:
merus of external maxillipeds not elongate: mandibular palp of either two or three joints, its terminal joint either simple or bilobed: 6th segment of male abdomen variable, but never more than twice as broad as long | 2 |
| | | Efferent branchial channels produced to the edge of the front, entrenching on and somewhat obscuring the epistome, cramping the antennæ, and so much contracting the antennular fossæ that the antennules fold almost longitudinally. | |
| 2 | { | | |

- | | | | |
|---|---|--|-------------------------------------|
| 2 | { | Mandibular palp of two joints, the terminal joint thickened and plumose at base, but not distinctly bilobed | DECKENININÆ. |
| | | Efferent branchial channels not thus produced | 3 |
| | { | Mandibular palp of either two or three joints, the terminal joint sometimes thickened and plumose at base, but not distinctly bilobed | POTAMONINÆ. |
| 3 | | Mandibular palp of two joints, the terminal joint deeply cut into two lobes, which embrace the incisor process of the mandible | 4 |
| | { | Abdomen of <i>adult</i> male usually broad at base and suddenly contracted at the 5th or 6th segment: the length of the sixth segment often exceeds and seldom falls short of its distal breadth: the seventh segment is almost always either elongate-triangular or tongue-shaped | GEARCINUCINÆ (PARATELPHUSINÆ). |
| 4 | | Abdomen of adult male not abruptly contracted distally: the sixth segment is usually much broader than long, and the seventh segment is broadly triangular: male abdominal appendages heavy, with blunt, lobed ends | PSEUDOTELPHUSINÆ (POTAMOCARCININÆ). |

KEY TO THE SUBFAMILIES OF POTAMONIDÆ.

- | | | |
|---|--|---|
| { | Terminal joint of mandibular palp deeply cut into lobes which embrace the incisor process of the mandible between them | 1 |
| | Terminal joint of mandibular palp consisting of a single lobe (the base of which may be sometimes thickened and plumose) lying behind the incisor process of the mandible ¹ | 2 |

¹ In some of the *Potamoninæ* the thickening of the base of the terminal joint of the palp is considerable, and as the hairs that fringe the thickening hang in a tuft over the incisor process of the mandible, the whole has somewhat the appearance of an independent lobe; this condition is most manifest in *Potamonantes* and in some of the African species of *Geotelphusa*, but it is not difficult to distinguish it from the broad, heavy, overhanging lobe of, e.g., *Paratelfusa tridentata*, if the palp be removed and denuded.

1	{	The length of the sixth abdominal segment of the adult male seldom falls short of its minimum breadth; the seventh segment is hardly ever broadly triangular ..	GECARCINUCINÆ (Old World, except Europe).
		The length of the sixth abdominal segment of the adult male is usually much less than its minimum breadth; the seventh segment is usually broadly triangular: male appendages peculiarly heavy and blunt	
2	{	Merus of external maxillipeds elongate: dactyli of crawling-legs non-spinose	PSEUDOTELPHUSINÆ (New World).
		Merus of external maxillipeds not elongate: dactyli of crawling-legs strongly spinose	
		Efferent branchial channels produced to the edge of the front ..	
3	{	Efferent branchial channels not abnormally produced	DECKENIINÆ (E. Africa, Seychelles).
		Efferent branchial channels not abnormally produced	

Subfamily POTAMONINÆ.

In this subfamily the terminal joint of the mandibular palp is never deeply cleft into two lobes, though it may sometimes be thickened and plumose at base. The abdomen of the *adult* male is almost never abruptly contracted distally; its sixth segment is almost always much broader than long, and its seventh segment is almost always broadly triangular.

It is safe to say that the subfamily is restricted to the Old World, being represented in Europe, Africa, Asia (abundantly), the Malay Archipelago, and (doubtfully) in Australia. One species—*Potamon* (*Geotelphusa*) *chilense*, Heller—is said to have come from Chili; but both the generic determination and the locality require confirmation, for there is nothing either in the description or in the figure published that affords conclusive evidence of its position.

The diagnostic features and the broad geographical distribution of the constituent genera are shown in the following synopsis:—

SYNOPSIS OF GENERA AND SUBGENERA OF POTAMONINÆ.

1	{	Antero-lateral borders of carapace serrulate or crenulate, but not strongly laciniate or spinose, though there may be a single lateral epibranchial spine ..	1	
		Antero-lateral borders of carapace strongly laciniate or spinose ..	2	
		Flagellum of exopodite of external maxillipeds strong ..	3	
		Flagellum of exopodite of external maxillipeds vestigial or absent		POTAMISCUS ¹ (India and China).
3	{	Post-orbital crests and lateral epibranchial spine very distinct ..	4	
		Post-orbital crests and lateral epibranchial spine indistinct or obsolete		GEOTELPHUSA ¹ (Asia, Malay Archipelago, Africa).
4	{	Edge of front spinulose ..		HYDROTELPHUSA (Madagascar).
		Edge of front entire	5	
5	{	Epigastric and post-orbital crests not continuous		POTAMON <i>subgenus</i> (Europe, Asia, Malay Archipelago, Africa).
		The epigastric and post-orbital crests of each side form an unbroken line		POTAMONAUTES ¹ (Africa).
2	{	Upper border of merus of chelipeds without a subterminal spine		PLATYTELPHUSA (L. Tanganyika).
		Upper border of merus of chelipeds with a subterminal spine or tooth	6	
6	{	Antennal flagellum and terminal joints of antennal peduncle vestigial and hidden		PARAPOTAMON (L. Yunnan Fu).
		Antennal peduncle and flagellum normal	7	
7	{	Eyes and eyestalks normal ..		ACANTHOTELPHUSA (Asia, Africa).
		Eyestalks somewhat tapering, eyes small		ERIMETOPUS (W. Africa).

¹ Subgenus of *Potamon*.

Potamon in the above synopsis refers to the subgenus only, the type of which is *P. potamios*. The species of this subgenus, as here limited, range from S. Europe, N. and E. Africa, and Madagascar, all through S. Asia, to China and the Malay Archipelago; but the subgenus is not represented in the peninsular part of India.

Potamiscus has hitherto been found only in N. E. India and Tongchuan Fu.

Geotelphusa ranges from Japan and S. Asia to N. and E. Africa. It may occur in Australia, but the only two Australian species attributed to *Geotelphusa* which I have been able to examine belong to the Gecarcinucine group *Liotelphusa*. It does not occur in the Indian peninsula, Kingsley's *Geotelphusa enodis* being, as I have lately ascertained by examination of specimens, a *Liotelphusa*.

Hydrotelphusa is peculiar to Madagascar. It is very like *Potamon*, but the thickening at the base of the terminal joint of the mandibular palp is more than ordinary prominent, and the sixth abdominal segment of the adult male is not so broad.

Potamonantes is confined to Africa; the Indian species that have been referred to *Potamonantes* belong to other groups.

Platytelphusa (= *Limnotelphusa*, Cunningham) is peculiar to Lake Tanganyika.

Acanthotelphusa is well represented both in E. Africa and S. Asia. It has not been found in the peninsular part of India.

Parapotamon seems to be restricted to L. Yunnan Fu. It includes two species—*P. endymion* and *P. spinescens*. In the former the merus of the external maxillipeds is somewhat longer and narrower than usual, and the exopodite of these appendages is non-flagellate; in the latter this is not the case. *Parapotamon* is, undoubtedly, closely related to *Acanthotelphusa*, but has the post-orbital crests almost obsolete.

Erimetopus, which is also a very near relative of *Acanthotelphusa*, is restricted to West Africa.

Subfamily DECKENIINÆ.

This subfamily comprises a single genus, *Deckenia*, with three constituent species, two of which are found in E. Africa and one in the Seychelles. The Seychelles species, judging from Miss Rathbun's figure, is a good deal unlike the other two.

No doubt the prolongation of the efferent branchial canals, which encroach on the epistome and alter the set of the antennæ and antennules, gives these crabs a peculiar appearance; but it seems to me that the ends of classification would be best served by placing *Deckenia* with the *Potamoninæ*.

Subfamily GECARCINUCINÆ.

In all the members of this large subfamily the mandibular palp is divided into two lobes, a dorsal and a ventral: the dorsal

lobe is falciform and lies behind the incisor process of the mandible; the ventral lobe, which is a broad oval plate, more or less covers the exposed surface of the incisor process. Very commonly the abdomen of the adult male is broad at base and is suddenly narrowed at the 5th or 6th segment; but, whether this is so or not, the length of the 6th segment is hardly ever less than (often exceeds) its minimum breadth, and the 7th segment is elongate-triangular or tongue-shaped—not broadly triangular.

The subfamily is restricted to the Old World, and is represented in Asia, Africa, the Malay Archipelago and Australia. All the *Potamonidæ* found in peninsular India belong to this subfamily.

It has already been mentioned that in certain *Potamoninæ* the terminal joint of the mandibular palp, when casually examined, appears to be bilobed: in any case of doubt the palp should be removed and denuded, or, better still, allowed to dry.

The following table shows the diagnostic characters of the constituent genera. The geographical distribution of the several genera cannot be stated with precision, since in the descriptions of species the points most necessary for focus are often not recorded:—

SYNOPSIS OF THE GENERA AND SUBGENERA OF
GECARCINUCINÆ.

I	{	Front in adult either not wider than or less than half again as wide as the orbit	I
		Front in adult usually much wider than, but never less than one-and-two-thirds as wide as the orbit	2
I	{	Lower outer corner of orbit produced into a sort of gutter ..	GEARCINUCUS (Peninsular India).
		Orbits normal	CYLINDROTELPHUSA (Peninsular India, New Guinea).
2	{	Upper border of merus of chelipeds with a subterminal spine ¹ ..	3 ¹
		Upper border of merus of chelipeds without any subterminal spine ..	4
3	{	Post-orbital crests prominent ..	Subgenus PARATELPHUSA (Asia, Malay Archipelago, Africa).
		Post-orbital crests faint or obsolete	PERITELPHUSA (Malay Archipelago).

¹ Except in *Paratelphusa blanfordi*, a Baluchistan species with broad spooned fingers, and in a few other species which, however, can be distinguished by having the antero-lateral borders of the carapace strongly spinose.

4	{	Post-orbital crests prominent ..	5	
		Post-orbital crests low, indistinct, or obsolete	6	
5	{	Epigastric and post-orbital portions of crests either continuous or almost in line		BARYTELPHUSA ² (Asia, Malay Archipelago, Africa?).
		Epigastric portion in advance of and slightly overlapping post-orbital portion of crest ..	7	
7	{	Exopodite of external maxillipeds strongly flagellate		OZIOTELPHUSA ² (Asia, Mauritius).
		Flagellum of exopodite of external maxillipeds vestigial or absent ¹ ..		PHRICOTELPHUSA ² (Asia).
6	{	Exopodite of external maxillipeds flagellate		LIOTELPHUSA ² (Asia, Malay Archipelago, Australia).
		Exopodite of external maxillipeds non-flagellate		GLOBITELPHUSA ² (Asia).

Subfamily PSEUDOTELPHUSINÆ.

This subfamily is restricted to the New World.

The mandibular palp is like that of the *Gecarcinucinae*: the abdomen of the adult male is like that of the typical *Potamoninae*.

Miss Rathbun bases the subfamily on the form of the merus of the external maxillipeds, which is said to be not so broad as usual and more obliquely-cut or emarginate internal to the insertion of the flagellum, and on the reduction of the exopodite of these appendages.

As regards the form of the merus, it is very variable within the limits both of the *Potamoninae* and of the *Gecarcinucinae*.

As regards the exopodite, there are *Potamoninae* in which the flagellum is absent, and there are *Gecarcinucinae* in which not only is the flagellum absent, but also the peduncle is much reduced. More than this: in the *Gecarcinucine* subgenera *Phricotelphusa* and *Globitelphusa* there are to be found exopodites of all lengths down to less than half the length of the ischium, and in *Phricotelphusa gageii* the exopodite may be flagellate or non-flagellate on one side or on both.

If the *Pseudotelphusinae* are to be separated from the *Gecarcinucinae*, which is a questionable proceeding I think, the separation must depend on the form of the abdomen of the adult male and of its appendages.

¹ In *Phricotelphusa gageii*, a Sikkim species, a slender flagellum may be present on the exopodite of one or both sides.


² Subgenus of *Paratelphusa*.

Subfamily TRICHODACTYLINÆ.

This subfamily is South American, straggling into Central America.

To me, as to Dr. Calman, its present position in the system is not altogether satisfactory.

There is no question that the members of this subfamily are very remarkably different from all other *Potamonidæ*, in many respects: the dactyli of the crawling-legs are devoid of the characteristic spines; the merus of the external maxillipeds is quite a long joint; the postero-lateral borders of the carapace are sharply defined; and in several species the middle segments of the particularly broad male abdomen are fused. Differences so numerous, and (for Cyclometope crabs) so great, appear to me to indicate a different ancestry.



XXVII. CATALOGUE OF THE PHEASANTS, PEAFOWL, JUNGLE FOWL AND SPUR FOWL IN THE INDIAN MUSEUM.

By C. W. BEEBE.

One of the most valuable helps in my work of obtaining data for a Monograph of the Pheasants has been constant study of the excellent series of skins in the Indian Museum. By the courtesy of Dr. Annandale these have been wholly at my disposal during my nine weeks of residence in India.

Finding that the collection was derived from several distinct sources, and that an inclusive catalogue was lacking, I have prepared one. This was made at the Museum during the period from March 26th to June 1st, 1910, and includes the Pheasants proper, Peafowl, Jungle Fowl and Spur Fowl. As it may prove useful to other future students of the collection, I have submitted it for publication.

C. WILLIAM BEEBE.

INDIAN MUSEUM,
May 31st, 1910.

Galloperdix spadicea (Gmel.).

B.M.C., xxii, 261.

18129	♂	Palni Hills, Madura Dist.,		
		Madras	..	W. Daly.
18458	♂	Maddathoray, Travancore	..	Mus. Coll.
18125	♂	Shevaroy Hills, Salem Dist.,		
		Madras	..	W. Daly.
1458B	♂	....	..	A.S.B.
18591	♀	Bangalore	..	Mus. Coll.
18127	♀	Palni Hills, Madura Dist.,		
		Madras	..	W. Daly.
18590	♀	Bangalore	..	Mus. Coll.
11801	♀	Bhoura	..	J. Armstrong.

Galloperdix lunulata (Valenc.).

B.M.C., xxii, 263.

7083	♂	(captive specimen)	..	W. Rutledge.
1457B	♂	....	..	A.S.B.
4169	♂	Ellichpur, Berar	..	W. T. Blanford.
1457D	♂	....	..	A.S.B.

18593	♂	Bangalore	..	..	Mus. Coll.
5351	♂	(captive specimen)	..	..	R. Mullick.
7269	♂	" "	..	..	W. Rutledge.
1457C	♂	" " " "	..	..	A.S.B.
12058	♀	Bhutan	..	..	W. Rutledge.
12059	♀	" "	..	..	" "
10859	♀	(captive specimen)	..	..	" "
4170	♀	" "	..	..	R. Mullick.
7271	♀	" "	..	..	W. Rutledge.
7274	♀	" "	..	..	" "
7270	♀	" "	..	..	" "
7272	♀	" "	..	..	" "
10860	♀	" "	..	..	" "
10861	♀	" "	..	..	" "
18604	♀	Bangalore	..	..	Mus. Coll.

Galloperdix bicalcarata (Penn.)

B.M.C., xxii, 264.

25225	♂	Ratnapura, Ceylon	..	Purchased.
25226	♀	" "	..	" "

Ithagene cruentus (Hardw.).

B.M.C., xxii, 268.

1455C	♂	" " " "	..	A.S.B.
17333	♂	(imm.) Sikkim	..	J. Scully.
17934	♂	Sandakphu, Sikkim	..	W. L. Sclater.
17935	♂	" "	..	" "
13806	♂	Sikkim	..	G. B. Mainwaring.
7988	♂	Darjeeling	..	" "
4102	♂	Yeomatong, Sikkim	..	W. T. Blanford.
3847	♂	Katmandu, Nepal	..	Mus. Coll.
12056	♀	(captive specimen)	..	W. Rutledge.
14820	♀	" "	..	" "
22364	♀	" "	..	" "
4362	♀	(no history).	..	" "

Tragopan satyra (Linn.).

B.M.C., xxii, 271.

17917	♂	Pindari Glacier, Kumaun	..	Mrs. Blissett (Oct., 1888).
7985	♂	Darjeeling	..	G. B. Mainwaring.
7984	♂	" "	..	" "
13436	♂	Kumaun Dist.	..	R. and A. Dept.
13437	♂	" "	..	" "
13590	♂	Kumaun	..	R. and A. Dept. (Col. Garstin).

13589	♂	Kumaun	..	..	R. and A. Dept. (Col. Garstin).
22146	♂	(captive specimen)		..	W. Rutledge.
4098	♂	Kumaun	..	..	Riddell Museum.
17332	♂	Nepal	..	..	J. Scully (Nov., 1877).
24980	♂	Katmandu, Nepal		..	J. Manners-Smith.
7260	♂	Bhutan	..	..	W. Rutledge.
1453G	♂	(imm.)	..	..	A.S.B.
24420	♂		....	..	D. Ezra.
13588	♀	Kumaun	..	..	R. and A. Dept. (Col. Garstin).
1453I	♀		....	..	A.S.B.
24983		Nepal	..	..	J. Manners-Smith.

Tragopan caboti (Gould).

B.M.C., xxii, 277.

23977	♂	(captive specimen)		..	W. Rutledge.
14817	♂	China	..	..	"
14818	♂	"	..	..	"
21457	♂	(captive specimen)		..	"
8351	♂	China	..	..	Purchased.
21347	♀	(captive specimen)		..	W. Rutledge.
14819	♀	China	..	..	"

Tragopan melanocephalus (Gray).

B.M.C., xxii, 273.

1452A	♂	(dismounted)	..	..	A.S.B.
4097	♀	Simla, W. Himalayas		..	F. Stoliczka.

Tragopan temmincki (Gray).

B.M.C., xxii, 275.

14816	♂	China	..	..	Calcutta Zool. Garden.
22908	♂	(dismounted; no history).			

Tragopan blythi (Jerd.).

B.M.C., xxii, 276.

12018	♂	Naga Hills, Assam		..	Calcutta Zool. Garden.
11970	♂	"	"	..	Capt. Williamson.
20604	♂	(imm.) Haka Hills (Chin-Lushai Hills), Northern Arakan, Burma, 7,000 ft.		..	O. L. Fraser.
14815	♂	Mishmi Hills, Assam		..	Capt. Molesworth.
1454A	♂	(mounted)	..	..	A.S.B.
10846		Mishmi Hills, Assam		..	C. R. Macgregor.

Lophophorus impeyanus (Lath.).

(Impeyan Moonal).

B.M.C., xxii, 278.

17330	♂	Sikkim	..	..	J. Scully (Jany., 1876).
7987	♂	Darjeeling	..	..	G. B. Mainwaring.
24982	♂	Nepal	..	..	J. Manners-Smith.
17329	♂	Nepal Valley	..	..	J. Scully (Jany., 1878).
13435	♂	Kumaun	..	..	R. and A. Dept.
17919	♂	Pindari Glacier, Kumaun	..	..	Mrs. Blissett (Oct., 1888).
17918	♂	..	..	..	..
13260	♂	....	..	..	R. D. Oldham.
19005	♂	....	..	..	Purchased.
22144	♂	(captive specimen)	..	..	Calcutta Zool. Garden.
22145	♂	..	..	..	..
25065	♂	Tista Valley	..	..	T. Bentham.
1477E	♂	(mounted)	..	..	A.S.B.
14828	♂	.. Nepal	..	..	Purchased.
13803	♀	Sikkim	..	..	G. B. Mainwaring.
17331	♀	..	..	..	J. Scully (Jany., 1876).
4132	♀	Darjeeling	..	..	T. R. Doucett.
24984	♀	Nepal	..	..	J. Manners-Smith.
24980	♀	..	..	..	..
17920	♀	Pindari Glacier, Kumaun	..	..	Mrs. Blissett (Oct., 1888).
13587	♀	Kumaun	..	..	R. and A. Dept. (Col. Garstin).
4136	♀	Simla, W. Himalayas	..	..	F. Stoliczka.
4134	♀	Mussoorie, United Provinces	..	..	Miss Milman.
19006	♀	Islamabad, Kashmir	..	..	O. L. Fraser.
5039	♀	(no history).	..	..	..
638	♀	..	..	..	..
1477B	♀	(dismounted ; captive specimen)	..	..	A.S.B.

Lophophorus sclateri, Jerdon.

B.M.C., xxii, 282.

7868	♂	Sadiya, Lakhimpur Dist., Assam	W. Bryden (July, 1874).
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Acomus erythroptthalmus (Raffl.).

B.M.C., xxii, 283.

4131	♂	Malacca	R. Mullick.
5038	♂	(captive specimen)	W. Rutledge.
814	♂	..	..	..	..
8358	♂	Penang	..	..	A. Guy.

Acomus pyronotus (Gray).

B.M.C., xxii, 284.

14839	♂	(captive specimen)	..	W. Rutledge.
14840	♂	„ „	..	„

Lophura rufa (Raffl.).

B.M.C., xxii, 286.

1465D	♂	(dismounted)	..	A.S.B.
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Lophura ignita (Shaw).

B.M.C., xxii, 288.

12065	♂	(captive specimen)	..	W. Rutledge.
25203	♂	„ „	..	Calcutta Zool. Garden.
22081	♀	„ „	..	W. Rutledge.
24423	♀	„ „	..	Calcutta Zool. Garden.

Diardigallus diardi (Temm.).

B.M.C., xxii, 290.

1471A	♂	(Head missing)	..	A.S.B.
14837	♂	(captive specimen)	..	W. Rutledge.
14838	♀	„ „	..	„

Crossoptilon manchuricum, Swinh.

B.M.C., xxii, 294.

22901	♂	(no history).		
14826	♂	(captive specimen)	..	R. Mullick.
14827	♂	„ „	..	„

Gennæus albocristatus (Vig.).

B.M.C., xxii, 298.

4124	♂	Kumaun	..	..	Riddell Museum.
4123	♂	Mussoorie	..	..	Miss Milman.
4122	♂	„	..	..	„
24453	♂	....		..	Purchased.
24456	♂	....		..	„
1470A	♂	(dismounted)	..	..	A.S.B.
4125	♀	Kumaun	..	..	Riddell Museum.
5204	♀	Simla, W. Himalayas	..	..	F. Stoliczka.
24454	♀	....		..	Purchased.
4121		Mussoorie	..	..	Miss Milman.
1470C	♀	(dismounted)	..	..	A.S.B.

Gennæus leucomelanus (Lath.).

B.M.C., xxii, 300.

17340	♂	Nepal Valley	..	..	J. Scully (Jany., 1878).
1470E	♂	(dismounted)	..	..	A.S.B.
17341	♀	Nepal Valley	..	..	J. Scully (Jany., 1878).
17342	juv.	„	..	..	„ (Aug., 1877).

Gennæus melanonotus (Blyth).

B.M.C., xxii, 301.

13804	♂	Sikkim	..	..	G. B. Mainwaring.
7178	♂	Bhutan	..	..	W. Rutledge.
18962	Type ♂	Sikkim	..	..	A.S.B. (E. Blyth).
18286	♂	Darjeeling	..	..	G. Masson.
8201	♂	„ Terai	..	..	J. Anderson.
13805	♂	„	..	..	G. B. Mainwaring (Nov., 1882).
4114	♂	„	..	..	H. J. Elwesby.
5200	♂	„	..	..	J. Anderson.
22159	♂	....	..	..	A. R. S. Anderson.
22158	♂	....	..	..	„ „
22160	♂	....	..	..	„ „
22161	♂	....	..	..	„ „
22155	♂	....	..	..	„ „
22160	♂	(mounted)	..	..	„ „
18287	♀	Darjeeling	..	..	G. Masson.
4115	♀	„	..	..	H. J. Elwesby.
22156	♀	....	..	..	A. R. S. Anderson.
22157	♀	....	..	..	„ „
18963	Type ♀	Sikkim	..	..	A.S.B. (E. Blyth).
18964	„ juv.	„	..	..	„ „

Gennæus horsfieldi (Gray).

B.M.C., xxii, 302.

19003	♂	....	..	..	Purchased.
4117	♂	Cachar, Assam	..	..	Mus. Coll.
4120	♂	South of Irrawaddy Div., L.	..	..	„
		Burma	..	..	„
10864	♂	(dismounted). Naga Hills,	..	..	„
		Assam	..	..	„
1668F	♂	(dismounted)	..	..	A.S.B.
4118	♀	Cachar, Assam	..	..	Mus. Coll.
4119	♀	South of Irrawaddy Div., L.	..	..	„
		Burma	..	..	„
1468B	♀	Assam	..	..	A.S.B. (Major Jenkins, 1844).

Gennæus cuvieri (Temm.).

B.M.C., xxii, 203.

23681	♂	(flat skin)	..	..	C. T. Bingham.
23682	♀	,,	..	.	,,

Gennæus lineatus (Vig.).

B.M.C., xxii, 304.

21437	♂	juv. (captive specimen)	..	W. Rutledge.
1467A	♂	(dismounted)	..	A.S.B.
1467C	♂	,,	..	,,
4128	(?)	albino, 20 miles from Rangoon		Hon'ble A. Eden.
1467D	♀	Arakan, Lower Burma	..	A.S.B. (Capt. Phayre).

Gennæus oatesi (Hume nec. Temm.).

1467F	♂	(captive specimen). Barrack-		
		pore Menagerie	..	A.S.B.
1467G	♀	Arakan, Lower Burma	..	,, (Capt. Phayre).

Gennæus andersoni (Elliot).

B.M.C., xxii, 306

2568	♂	(rectrices only)	..	J. Anderson (Yunnan Expedition).
18965	Type ♂	Kakhyen Hills to the East of Bhamô	..	,,
25204	♂	,,	..	,,

Gennæus nycthemerus (Linn.).

B.M.C., xxii, 307.

18697	♂	....	..	Purchased.
22293	♂	(captive specimen)	..	W. Rutledge.
1466D	♂	(dismounted)	..	A.S.B.

Gennæus swinhoii (Gould).

B.M.C., xxii, 309.

18560	♂	Purchased.
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Pucrasia macrolopha (Less.).

B.M.C., xxii, 311.

1472A	♂	(mounted)	..	A.S.B.
19049	♂	Sayree, Pethoragurh, Kumaun, U.P.	..	Lucknow Museum (Mus. Coll., May, 1886).

19051	♂	Kumaun, U.P. . . . .	..	Lucknow Museum.
19048	♂	Moor Nowlee, Bhim Tal, Kumaun, U.P. . . . .	..	Lucknow Museum (G. Reid, June, 1886).
5205	♂	Simla, W. Himalayas		F. Stoliczka.
1477D	♂	.....	..	A.S.B.
19007	♀	Islamabad, Kashmir	..	O. L. Fraser.
4103	♀	Mussoorie, U.P.	..	Miss Milman.
1472B	♀	(captive specimen). Barrack-pore Menagerie	..	A.S.B.

Phasianus shawi, Elliot.

B.M.C., xxii, 326.

17335	♂	Yarkand	..	J. Scully (Feb., 1875).
17337	♂	„	..	„ (May, 1875).
17334	♂	Kashgar	..	„ (Nov., 1874).
17336	♂	Yarkand	..	„ (Mar., 1875).
20278	♂	near Yarkand	..	Yarkand Expedition, 1873-74. F. Stoliczka
20280	♂	Yarkand	..	„ „
20279	♀	near Yarkand	..	„ „
17338	♀	Yarkand	..	J. Scully (Mar., 1875).

Phasianus sp. (*colchicus*?)

7465	♂	albino (captive specimen)	..	W. Rutledge.
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Phasianus principalis principalis, Scl.

B.M.C., xxii, 325.

14307	♂	Maruchak, Murghab, Herat	..	Afghan-Baluch. Commission (Capt. Yate).
14306	♂	„	..	„ „
14305	♂	Chahar Shamba, Maimanah	..	„ „
14517	♂	Bala-morghab, Badghis	..	Afghan Delim. Commission.
14516	♂	„	..	„ „
14480	♂	Gooldan	..	Purchased.
14481	♀	„	..	„ „
14308	♀	Maruchak, Murghab, Herat	..	Afghan-Baluch. Commission (Capt. Yate).
14309	♀	„	..	„ „

Phasianus principalis komarowi, Bogd.

20393	♂	Taraja-jacy	..	D. G. Radde (Nov., 1886).
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Phasianus elegans, Elliot.

B.M.C., xxii, 329.

9057	♂	Momien (= Tengyueh), Yunnan	J. Anderson (Yunnan Expedition).
9055	♂	„ „ „ „ „	„ „ „
2570	♀	„ „ „ „ „	„ „ „
9052	♀	Momien (= Tengyueh), Yunnan	J. Anderson (Yunnan Expedition).
9053	juv.	„ „ „ „ „	„ „ „
9054	juv.	„ „ „ „ „	„ „ „

Phasianus torquatus, Gmel.

B.M.C., xxii, 331.

7573	♂	(captive specimen)	.. R. Mullick.
7265	♂	„ „	.. W. Rutledge.
7507	♂	„ „	.. R. Mullick.
23978	♂	„ „	.. O. Thomas.
14831	♂	semi-albino (captive specimen)	R. Mullick.

Phasianus soemmerringi scintillans, Gould.

B.M.C., xxii, 337.

14832	♀	(captive specimen)	.. Calcutta Zool. Garden.
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Calophasis humiae, Hume.

B.M.C., xxii, 335.

17914	♂	Ruby Mines, U. Burma	.. Capt. Daly.
25205	♂	Kanpilet „ „	.. „ „
25206	♂	(no history).	
25207	♀	„ „	

Calophasis ellioti (Swinh.).

B.M.C., xxii, 335.

14833	♂	(captive specimen)	.. W. Rutledge.
23694	♀	„ „	.. Calcutta Zool. Garden.

Syrnaticus reevesi (Gray).

B.M.C., xxii, 337.

22295	♂	China „	.. W. Rutledge.
14830	♂	(captive specimen)	.. R. Mullick.
19002	♂	„ „	.. Purchased.
7266	♂	China „	.. W. Rutledge.

Chrysolophus pictus (Linn.).

B.M.C., xxii, 339.

18559	♂	....	..	Purchased.
23808	♂	(captive specimen)	..	Calcutta Zool. Garden.
17921	♂	....	..	....
18641	♂	....	..	Purchased.
22352	♂	(captive specimen)	..	W. Rutledge.
22083	♂	(no history).		
22294	♂	China ..	..	W. Rutledge.
12066	♂	....	..	....
20601	♂	mounted ..	..	....
23910	♀	,, (captive specimen)		Calcutta Zool. Garden.

Chrysolophus amherstiae (Leadb.).

B.M.C., xxii, 342.

11006	♂	(captive specimen)	..	W. Rutledge.
14836	♂	,,	..	R. Mullick.
1476A	♂	(imperfect skin)	..	A.S.B. (B. H. Hodgson, 1843).
12068	♀	(captive specimen)	..	W. Rutledge.
12067	♀	,,	..	,,
9059	♀	Momien (= Tengyueh), Yunnan, 6,000 ft.	..	J. Anderson.

Catreus wallichii (Hardw.).

B.M.C., xxii, 317.

1473C	♂	mounted ..	..	A.S.B. (1847).
4129	♂	Kumaun, U.P. ..	..	Riddell Museum.
19052	♀	Pethoragurh, Kumaun, U.P.		Lucknow Museum (Nov., 1885).
19053	♀	Garhwal, ,,	..	Lucknow Museum (J. S. Campbell, March, 1888).
1473B	♀	....	..	A.S.B. (Capt. Thomas, 1845).
4130	♀	Darjeeling (probably incorrect locality) ..	..	T. R. Doucett.

Gallus gallus (Linn.).

B.M.C., xxii, 344.

5209	♂	Darjeeling ..	..	J. Anderson.
4108	♂	,, ..	..	,,
18921	♂	Gaya District, Bengal	..	Mus. Coll.
18922	♂	,, ,,	..	,,
18923	♂	,, ,,	..	,,
18920	♂	,, ,,	..	,,

9047	♂	Ponsee, Kakhyen Hills, 3,300 ft.	J. Anderson.
1462	♂	dismounted	A.S.B.
21675	♂	.... ..	A. R. S. Anderson.
21629	♂	.... ..	G. King.
4105	♂	S. of Irrawaddy, L. Burma ..	Mus. Coll.
4106	♂	Sibsagar, Assam ..	S. E. Peal.
21676	♂	.... ..	A. R. S. Anderson.
21673	♂	mounted .. ..	..
25159	♂	.., Parasnath Hill, Bengal ..	..
1462A	♂	mounted. Hazaribagh, Bengal	A.S.B.
18925	♀	Gaya District, Bengal ..	Mus. Coll.
18924	♀	.., .. ..	..
4109	♀	Cachar, Assam .. ..	..
9051	♀	Upper Burma, 600 ft. ..	J. Anderson.
24996	♀	Nepal	Mus. Coll. (R. Hodgart).
1462B	♀	Midnapur Dist. ..	A.S.B.
21674	♀	.... ..	A. R. S. Anderson.

Gallus gallus, domestic varieties.

22174	mounted.	Japanese Bantam cock	Purchased.
22177	..	Malay cock ..	..
22027	..	White-crested Polish hen	W. Rutledge.
25209	..	Chittagong cock ..	A. C. Chowdhary.
25210	..	.. ..	..
1462P	..	Partially hen-feathered cock. ¹	A.S.B.

Gallus varius (Shaw and Nodd.).

B.M.C., xxii, 352.

25211	♂	mounted (captive specimen) ..	Calcutta Zool. Garden.
22877	♂	(captive specimen), ..

Gallus lafayettii, Less.

B.M.C., xxii, 348.

25224	♂	Anuradhapura, N.C.P., Ceylon	Purchased.
25223	♀	.., .., ..	..

Gallus sonnerati, Temm.

B.M.C., xxii, 350.

18122	♂	Shevaroy Hills, Salem Dist., Madras ..	W. Daly.
18588	♂	Bangalore, Mysore ..	Mus. Coll.
18587	♂	.., .. ..	..
18586	♂	.., .. ..	..
18612	♂	South Arcot, Madras ..	..

¹ Type of *G. "pseudhermaphroditus,"* Blyth (Journ. As. Soc. Bengal, x (2), p. 925, 1841).

25208	♂	(captive specimen)	..	Calcutta Zool. Garden.
1464A	♂	mounted	..	A.S.B.
1464N	♂	dismounted	..	..
4112	♂	East of Baroda, C. India	..	W. T. Blanford.
22703	♂	(captive specimen)	..	W. Rutledge.
18124	♀	Shevaroy Hills, Salem Dist.,	..	..
		Madras	..	W. Daly.
18123	♀	..	..	..
11807	♀	Bhoura, 2,500 ft.	..	J. Armstrong.
4111	♀	East of Baroda, C. India	..	W. T. Blanford.
11839	♀	Bhoura, 2,500 ft.	..	J. Armstrong.
1464B	♀	....	..	A.S.B.
18614	♀	South Arcot, Madras	..	Mus. Coll.

Polyplectrum chinquis (Müll.).

B.M.C., xxii, 354.

4141	♂	Cachar, Assam	..	Mus. Coll.
5717	♂	....	..	....
7340	♂	Naga Hills, Assam	..	W. Rutledge.
22162	♂	mounted	..	A. R. S. Anderson.
22524	♂	(captive specimen)	..	Calcutta Zool. Garden.
14821	♀	..	..	W. Rutledge.

Polyplectrum bicalcaratum (Linn.).

B.M.C., xxii, 357.

1460B	♂	Malacca	..	A.S.B.
4142	♂	..	..	A. B. Spray.
21350	♂	(captive specimen)	..	W. Rutledge.
12060	♂	..	..	..
12061	♂	..	..	..
14822	♂	Bhutan	..	..
6311	♂	(dismounted ; captive specimen)	..	..
5970	♂	no history.	..	..
6601	♀	(dismounted ; captive specimen)	..	W. Rutledge.
6603	♀	..	..	..
14823	♀	(captive specimen)	..	..
12062	♀	..	..	..

Argusianus argus (Linn.).

B.M.C., xxii, 363.

25213	♂	(captive specimen)	..	Calcutta Zool. Garden.
1461G	♂	dismounted	..	A.S.B.
1461B	♂	.. Malacca	..	..
3894	♂	....	..	....
18063	♂	Perak	..	Mus. Coll.
18069	♂	Tenasserim	..	Malet.

18065	♂	Perak	..	..	Mus. Coll.
22166	♂	(captive specimen)		..	W. Rutledge.
21346	♂	"	"	..	"
22141	♂	"	"	..	"
25214	♂	mounted	..	..	....
21428	♀	(captive specimen)		..	W. Rutledge.
18066	♀	Perak	..	..	Mus. Coll.
13447	♀	Malacca	..	..	Bengal Economic Museum.
14825	♀	Singapore	..	..	A.S.B.
5926	♀	no history.			
6326	♀	(dismounted; captive specimen)		W.	Rutledge.
25215	♀	mounted	..	..	....

Pavo cristatus, Linn.

B.M.C., xxii, 368.

1449B	♂	(specimen in bad condition)	..	A.S.B.
23685	♂	(captive specimen)	..	Calcutta Zool. Garden.
23825	♂	"	"	"
25092	♂	Shakwani, Nepal	..	J. Manners-Smith.
24433	♀	no history.		

White var.

21343	♂	(captive specimen)	..	W. Rutledge.
25215	♂	no history.		
25218	juv.	"		

Black-winged var. (*P. "nigripennis."*)

25216	♂	....	..	Purchased.
1449	♂	dismounted	..	A.S.B.

Pavo muticus, Linn.

B.M.C., xxii, 371.

21438	♂	(captive specimen)	..	Calcutta Zool. Garden.
23077	♂	"	..	W. Rutledge.
22701	♂	"	..	"
19269	♂	mounted	..	....
21217	♂	no history.		
22140	♀	(captive specimen)	..	W. Rutledge.





XXVIII. ON CERTAIN SPECIES OF *PALAEMON* FROM SOUTH INDIA.

By J. R. HENDERSON, *M.B., F.L.S.*, and GEORGE
MATTHAI, *M.A.*

The collection of freshwater prawns on which the following observations are based is one formed during a number of years, and comprising specimens collected at various localities in the Madras Presidency, from Ganjam to Tranquebar on the east coast, and from Mangalore to Travancore on the west coast. In most of the species reported on, a large series of individuals has been obtained at all stages of growth. Altogether nine species are described, and of these two are regarded as new to science, while in the present state of our knowledge of the genus, and as a matter of convenience, we have considered it advisable to assign a name to a third form which may prove to be only a variety of a previously known species.

Species of *Palaemon* are found abundantly throughout Southern India, wherever there are more or less permanent tanks (ponds and lakes) or rivers. We have obtained *P. carcinus* from the back-water at Cochin, but with this exception have not met with any of the other species in salt water. Freshwater prawns form an article of food among the poorer classes, but in this respect are inferior to marine prawns (*Penaeus*).

Comparatively little attention has been paid to the Indian species of *Palaemon*. Forms from Central and Northern India have been described by Milne-Edwards, Henderson, and de Man, while for Southern India there is the original description of the genus by Fabricius (Supplem. Ent. Syst.) and a recent paper by the late Dr. Giuseppe Nobili (Boll. Mus. Zool. Torino). Fabricius in 1798 described three species from South India, *P. tranquebaricus*, *P. brevipennis*, and *P. coromandelianus*, but the diagnoses are so brief that the forms are unrecognisable; all three probably occur among the species which we are about to describe. Nobili records seven species from Pondicherry, but this number can be reduced to five, all of which are present in our collection. The only one to which he assigns a new name, *P. alcocki*, is, we are convinced, a young example of probably *P. rudis*, Heller. He also briefly describes a single small specimen which he refers to *P. multidentatus*, Coutière, from Madagascar. It is impossible to identify this last from Nobili's description, but in any case a reference to Coutière's paper shows that his species was undoubtedly based on immature specimens, and in our opinion the name should be suppressed.

Owing to the great differences which exist between young and old individuals, and between the two sexes, considerable difficulty is often experienced in determining the species of *Palaemon*. As a rule, new species should not be described in the absence of a series of individuals of both sexes at different periods of growth, and certainly never from individuals which do not appear to be adult. In some cases where adult males show clearly marked differences, e.g., *P. rudis* and *P. idae*, very young individuals of the same species are almost indistinguishable, and the adult females can only be separated with considerable difficulty. Descriptions of new species which have not been largely based on an examination of adult males are therefore likely to be misleading, and lack of attention to this general principle has largely contributed to the numerous synonyms with which the genus *Palaemon* is overburdened.

The most reliable specific characters are those derived from the form and relative length of the joints in the larger chelipedes of adult males, and the general form and toothings of the rostrum in both sexes. In opposition to Ortmann we do not attach much importance to the shape of the telson-tip, which sometimes varies greatly in members of the same species; but we find that useful characters can frequently be obtained from the relative lengths of the two sub-terminal spinules when compared with the telson-tip. The division of the genus into four groups, *Eupalaemon*, *Brachycarpus*, *Parapalaemon* and *Macrobrachium*, which has been proposed by Ortmann, is of doubtful utility, for the characters on which they are founded depend to some extent on the age of the individual. Thus *P. scabriculus*, when young is a *Eupalaemon*, when older a *Parapalaemon*, and very old males might be placed in the group *Macrobrachium*.

In the case of our species the examination of a large number of individuals of different sizes seems to establish the following facts in regard to the modifications of structure which accompany growth:—

1. The rostrum in the young is relatively longer than in the adult.
2. The larger chelipedes, always shorter than the body in the young, are usually much longer than the body in the adult. In species with the chelipedes of the second pair very unequal, the latter part of this statement only applies to the larger chelipede.
3. The merus and carpus of the larger chelipedes as a rule remain of the same relative length.
4. The ischium grows much more slowly than the merus and carpus, with the result that while in the young it is either equal to or longer than the merus, in the adult it is always shorter than the merus.
5. The palm grows much faster than the merus, carpus and fingers, so that while usually shorter than the carpus

in the young, it equals or sometimes even exceeds the latter joint in the adult.

6. The fingers (except in the case of *P. idae*) grow a little more quickly than the carpus and merus, but less rapidly than the palm.

The following sexual characters, though common to other *Macrura*, are of some practical importance; the thoracic legs of the female are not so approximate at their bases as in the male, and this is particularly the case with regard to the last pair of legs; the ventral surface of the abdomen is also wider in the female, and the abdominal epimera which form a lateral protection for the eggs attached to the abdominal appendages, are of greater depth, especially those of the first three segments. Of much greater importance, however, are the special sexual characters of the genus. The female is smaller than the male. The rostrum in the female is usually comparatively longer than in the male, and in species in which it is upturned distally that of the female is more distinctly curved. The chelipedes in the female are always much thinner and shorter than those of the male. The spinosity and pubescence of the chelipedes, carapace and legs, which frequently characterise males, are much less strongly developed and in some cases even totally absent from females. The fingers of the female are of equal length, and the teeth or tubercles on their ridges weak or absent, while their tips are less curved than those of the male. Coutière has drawn attention to an apparent preponderance of males in the genus *Palaemon*, but we imagine that this is partly due to a process of selection by collectors, for in most of our species females were met with in as great numbers as males.

The subject of dimorphism in the males of *Palaemon* is one of considerable interest. While the young individuals of any species are all very much alike, it is not till a later stage, when the maximum size of the individual is practically attained, that the male characters definitely assert themselves. In many if not in all species, two forms of male are to be met with, *viz.*, normal males usually of considerable size, with the larger chelipedes specially developed, and males of the second type ("mâles féminisés" of Coutière) generally smaller but sometimes attaining the same size as normal males, in which the chelipedes resemble those of females.

Dimorphism of the males has been recorded in several species of Decapod Crustacea, and it has been shown, notably by Faxon in crayfishes of the genus *Cambarus*, that the two forms represent breeding and non-breeding stages, which alternate in the life history of each individual. In order to ascertain if any similar alternation exists in *Palaemon*, we have recently (September and October) examined the reproductive organs of a large number of males of *P. malcolmsoni*, *P. dubius*, and *P. scabriculus*, but with negative results. We find that in these three species many males of the second type, with the larger chelipedes undeveloped, appear to be sexually mature; their testes are well-developed, and in all

those examined free spermatozoa were found in the vasa deferentia. In normal males similar conditions were met with, but the testes were proportionately larger, and the vasa deferentia more coiled. We met with free spermatozoa in a male of *P. dubius*, which measured only 37 mm. in total length, with the chelipedes subequal and only about half the length of the body, yet the general appearance of this specimen, and more particularly of its chelipedes, would have led to the assumption that it was a young individual. A specimen of *P. malcolmsonii*, measuring only 93 mm. in total length, with chelipedes considerably shorter than the body, contained free spermatozoa in abundance in the vasa deferentia. The spermatozoa of *Palaemon* have a single process springing from a head, the free surface of which is convex, so that the whole structure bears some resemblance to an umbrella.

With regard to the last three forms on our list, *P. scabriculus*, *P. dolichodactylus*, and *P. dubius*, we have encountered problems of considerable perplexity, and are strongly disposed to think that they may all belong to one and the same species. Specimens of all three forms of adult male were taken together in the same tanks, along with adult females which appeared to be all of one type, and a careful examination failed to reveal any differences among them such as one would have expected had there been three species. Very young males collected under the same conditions were also alike, and finally there appeared to be connecting links between the three forms of adult male. If our view, which amounts almost to a conviction, can be established, we have here to deal with a species in which the males exhibit polymorphism, and we would hazard the opinion that a number of the so-called species of *Macrobrachium* are based upon similar varieties of male.

In some of the species there appears to be considerable variation in the size of adult individuals. In *P. malcolmsonii*, we have females with eggs ranging in total length from 90 mm. to 118 mm., and our largest female (one without eggs) measures 133 mm. In this species we also find males with all the special characters developed, from 191 mm. to 230 mm. in length.

Parasites and commensals are occasionally met with on some of the species. A *Probopyrus* is met with, sometimes abundantly, on *P. malcolmsonii*, inhabiting the branchial chamber of either side, and we have found a similar parasite in single specimens of *P. rudis* (right side) and *P. scabriculus* (left side). In all cases the infected host suffers an arrest in growth, and the male chelipedes resemble those of females, an observation which has frequently been made with regard to other instances of parasitism in Decapod Crustacea. Specimens of *P. malcolmsonii*, from the neighbourhood of Madras, are occasionally found with the chelipedes, carapace, and abdominal terga, covered by algae, and the polyzoon *Victorella bengalensis*, Annandale.

In the descriptions which follow the total length of the prawn is taken from the tip of the rostrum to the apex of the telson. In the measurements of the chelipedes the coxa and basis are not

included. All measurements are in millimetres, and are taken in the case of joints from the dorsal side. The *ischium*, *merus*, *carpus*, *palm*, and *fingers* of the large chelipedes, are indicated respectively by their initial letters i., m., c., p., f.; the abbreviations im. f., and m. f., stand for the *immobile* and *mobile* fingers respectively.

The term *young* as applied by us includes specimens with the chelipedes shorter than the body; it does not necessarily imply that the individuals are sexually immature.

PALAEEMON CARCINUS, Fabricius.

(Pl. xv, figs. 1a—g.)

P. carcinus, Fabricius, Suppl. Ent. Syst., p. 402 (1798); Milne-Edwards, Hist. Nat. des Crust., t. ii, p. 395 (1837); Ortmann, Zool. Jahrb. Syst., Bd. v, p. 700 (1891); de Man, in Max Weber's Zool. Ergebn., p. 421 (1892).

Characters of adult males.—The rostrum is long, and exceeds the antennal squame by nearly one-fifth of its length; it is bent near the middle and upturned distally. The tooth formula is $\frac{12 \text{ to } 15}{10 \text{ to } 14}$ (most commonly $\frac{12 \text{ to } 13}{11 \text{ to } 13}$); the seventh to the eleventh teeth are usually separated by wider intervals than the others. The first three upper teeth, or rarely the first two, are on the carapace.

The large chelipedes are sub-cylindrical and either equal or sub-equal; they are nearly half as long again as the body; a longitudinal pale line traverses the upper and lower surfaces of the palm, carpus, and sometimes the merus. The joints are beset with broad-based spines, which are less strongly developed on the ischium and the immobile finger, and absent from the mobile finger. The distal end of the carpus is about the same width as the palm, while the latter is of uniform width. The finger-tips are strongly incurved, more especially that of the mobile finger. The mobile finger is stouter than the immobile finger, and is densely pubescent, a fact which causes it to look stouter than it really is. The tooth on the immobile finger is conical, while the crenation of the ridge situated proximally to this tooth is well pronounced; the proximal tooth of the mobile finger may, in some cases, be followed by a small tubercle. When the fingers are closed, the tooth on the immobile one lies nearer the proximal than the distal tooth of the mobile finger. The following measurements are taken from the chelipede of an adult specimen (dried) measuring 295 mm. in total length:—

i. 38 m. 85 c. 110 p. 112 f. 89.

The telson-tip is acutely pointed; the inner sub-terminal spinule on each side projects backwards beyond the outer one, but does not nearly reach the tip of the telson itself.

The whole surface of the body is conspicuously punctate, but this characteristic is less marked on the carapace.

The colours of fresh specimens are as follows :—Deep peacock blue on the large chelipedes, passing into green on the palm and fingers; this coloration is absent from the coxal and basal joints, and is deeper on the upper than on the under surface. The ambulatory legs are pale blue; the spines on the legs are deep blue at the base, and orange towards the apex. The body is flesh-coloured; the abdominal segments have deep blue transverse bands, which are broadest on the fourth, fifth and sixth segments.

Characters of females.—The rostrum is more strongly upturned distally, and is somewhat less deep than in adult males.

The large chelipedes are more than half the length of the body; they are beset with feebly developed spines, those on the ischium and fingers being the weakest, while there are none on the mobile finger. The palm is slightly compressed dorso-ventrally, and is about the width of the distal end of the carpus. The mobile finger is stouter than the immobile, but not to the same extent as in males, nor is it so densely pubescent. When the fingers are closed, the distal tooth of the immobile finger lies midway between the two teeth on the mobile finger.

The following measurements show the length of the joints of the large chelipedes in an adult female (dried) measuring 232 mm. in total length :—

i. 35 m. 32 c. 43 p. 35 f. 27.

Characters of young individuals.—In specimens under 200 mm. in total length the rostrum closely resembles that of the adult female.

In an individual measuring 139 mm. in total length, the joint measurements are as follows :—

i. 17.5 m. 16 c. 20 p. 17 f. 14.5.

With advancing age the coloration of the body deepens, the mobile finger becomes much stouter than the immobile, the pubescence appears on the former, and the punctation on the body becomes more pronounced.

This species is the largest, and one of the best known members of the genus. It has been recorded from many localities in the Indo-Malayan region, from India to New Guinea, and has been so often and so fully described that a fuller description than that given above is unnecessary.

Localities.—From many localities in the Malabar District, Cochin State, Travancore State; Godaveri District (Rajahmundry and Cocanada); Chingleput District (Red Hills and other localities near Madras). We have obtained adult males and females from the back-waters of the Cochin State near Ernakulam, a fact which is of some importance since the genus *Palaemon* is chiefly met with in fresh water.

P. MALCOLMSONII, H. Milne-Edwards.

(Pl. xv, figs. 2a—f.)

P. malcolmsonii, H. Milne-Edwards in Jacquemont's "Voyage dans l'Inde," Crustacés, p. 8, pl. iii (1844).

P. danae, Nobili, Boll. Mus. Zool. di Torino, vol. xviii, n. 452, p. 7 (1903).

Characters of adult males.—The rostrum projects beyond the antennular stalk for about one-fifth of its length. Its upper margin consists of a toothed highly convex proximal part, and a much shorter more or less straight distal part, which carries only one or two teeth near the apex. The proximal portion is relatively deep, while the terminal portion is much narrower. The tooth formula is $\frac{9 \text{ to } 11 + 1 \text{ or } 2}{5 \text{ to } 7}$ (most commonly $\frac{10 \text{ to } 11 + 1}{6}$). As in *P. carcinus* the first three upper teeth or rarely the first two are on the carapace.

The large chelipedes, which are sub-equal in length, resemble those of *P. carcinus*, but the spinules are not so strongly developed, and are more closely set; the movable finger is somewhat less pubescent; the chelipedes are less than double the body-length. A groove traverses both the upper and lower surfaces of the palm and carpus, recalling the longitudinal lines visible in *P. carcinus*. The following measurements are taken from the chelipede of an adult specimen (dried) measuring 191 mm. in total length:—

i. 44 m. 71 c. 95 p. 86 f. 46.5.

From the above measurements, it will be seen that the ischium and fingers are both relatively shorter than in adult males of *P. carcinus*.

The telson-tip, as in *P. carcinus*, is acutely pointed. The inner sub-terminal spinule on each side projects backwards beyond the outer one, but does not nearly reach the telson-tip.

The anterior surface of the carapace, the postero-ventral regions of the first five abdominal epimera, the anterior region of the second abdominal epimeron and sometimes of the first, fifth and sixth abdominal terga, and the upper surface of the telson are scabrous. The thoracic legs, with the exception of their dactyli, are provided with very numerous closely set spinules.

Characters of females.—The rostrum may be slightly upturned distally, and extends as far as, or a little beyond, the distal margin of the antennal squame; sometimes the upper penultimate tooth is midway between the ultimate and antepenultimate teeth.

The large chelipedes are scabrous, and are about two-thirds the length of the body. The palm is slightly compressed dorso-ventrally, and is of uniform width; it is as wide as, or slightly wider than, the distal end of the carpus. The mobile finger is not pubescent. The grooves on the carpus and palm which are charac-

teristic of males are absent in the female. In a specimen measuring 118 mm. in total length, the joint-measurements are as follows:—

i. 16 m. 15 c. 19 p. 16 f. 11.

The body is smooth and exhibits none of the roughness characteristic of males.

Females with eggs vary from 90 to 118 mm. in total length; the largest specimen from Tanjore is without eggs, and measures 133 mm. in length.

Characters of young individuals.—In individuals under 110 mm. in total length the rostrum may be slightly upturned distally, and may extend a little beyond the distal margin of the antennal squame.

A table of measurement taken from male individuals is given, to show the changes which accompany growth in regard to the relative lengths of the joints of the large chelipeds.

No.	Locality.	Total length of body.	Total length of chelipede.	LARGE CHELIEPEDE.				
				Ischium.	Merus.	Carpus.	Palm.	Finger.
I	Bezawada ..	68	34.75	8	7	8.75	6	5
II	Chingelput ..	73	46.5	9.5	9	12	9	7
III	Surada reservoir ..	87	62	12.5	12.5	16	12	9
IV	" ..	98	89.75	15.5	18	23.75	18.5	14
V	" ..	118	127.25	20	24.75	32	28	22.5
VI	Godavery River ..	131	142.5	22.5	25.75	33	33	28.25
VII	Karoor ..	155	171.5	28	33	41	40	29.5
VIII	Tanjore ..	191	342.5	44	71	95	86	46.5
IX	Renigunta ..	230	442	51	92	115	115	69

No. VIII in the above table, though much smaller than No. IX, presents adult characters, and hence it appears that there is considerable variation in size in adult males also.

General remarks.—*P. danæ*, Heller, judging from the original figure, is perhaps based on young specimens of *P. malcolmsonii*. Nobili has referred to *P. danæ* certain specimens from Pondicherry, the largest of which measured 65 mm. in total length; these we have little doubt in regarding as young individuals of *P. malcolmsonii*. *P. weberi*, de Man, which is undoubtedly a distinct species, agrees closely with *P. malcolmsonii* in the shape and toothings of the rostrum. It is extremely probable that the common South Indian species described above, was one of those originally diagnosed by Fabricius, and we possess a well-developed male specimen from Tranquebar, the locality which furnished the Danish naturalist with his type specimens. It is impossible, however, to determine from his brief descriptions to which of the species it belongs.

Localities.—This species, originally described by Milne-Edwards from Nagpore, is the commonest freshwater prawn in Southern India. It has not so far been recorded from any locality

outside India. We have a large number of specimens from the following localities:—

Ganjam District (Surada Reservoir and Berhampore), Kistna District (Bezawada Anicut), Godaveri District (Rajahmundry), Madras District, Chingleput District (Chingleput, Pallavaram, Red Hills and Walajabad), North Arcot District (Renigunta), Trichinopoly District (Trichinopoly), Tanjore District (Tanjore and Tranquebar), Coimbatore District (Karooor).

We have not so far obtained any specimens from the Western side of India.

P. IDÆ, Heller.

(Pls. xv, figs. 3a—c, and xvi, figs. 3a—l.)

P. idæ, Heller, Sitz.-Ber. Akad. Wiss. Wien, Bd. xlv, p. 416, tab. ii, figs. 40, 41 (1862); Ortmann, l.c., p. 717 (1891).

P. sundaicus, Heller, l.c., p. 415, tab. ii, figs. 38, 39 (1862); Ortmann, l.c., p. 719 (1891); de Man, in Max Weber's Zool. Ergebn., p. 437, tab. xxvi, fig. 35, p. 437 (1892); Nobili, l.c., p. 8 (1903).

Characters of adult males.—The rostrum extends as far as, or a little behind, the distal margin of the antennal squame; its proximal portion is deep, and shows slight convexity above, while the narrow terminal part is straight or slightly upturned. The tooth formula is $\frac{12-15}{4-6}$ (most commonly $\frac{13}{4}$); the first and second upper teeth are separated by a wider interval than any of the others, and these, with in rare instances a third tooth, are on the carapace. The two distal teeth are separated by a narrower interval than the other teeth, while a somewhat wide gap separates the first of these from the proximal series; in some cases there are three teeth in the distal series, and very exceptionally four teeth.

The large chelipedes are slender, sub-cylindrical, and sub-equal; their length is more than one and a half times the length of the body. The joints are beset with short blunt almost tubercular spines, which, however, are feebly developed on the ischium and fingers. These tubercles are arranged in approximately longitudinal rows. The proximal portion of the carpus is of the same width as the palm, while its distal portion is wider than the latter. The palm is very slightly compressed laterally at its distal end. The fingers are usually of equal thickness, and the finger-tips are incurved; the inner margin of the immobile finger, and the whole surface of the mobile finger are pubescent; the ridges on the opposed edges of the fingers are less strongly developed than in *P. carcinus* and *P. malcolmsonii*. The tooth on the immobile finger is acute, and in some male specimens from Mangalore, the front margin of the teeth on the fingers is somewhat convex; the teeth on the mobile finger are not so wide apart as in *P. carcinus* and *P. malcolmsonii*; and the proximal tooth is less prominent than

the distal one. When the fingers are closed, the tooth on the immobile finger lies nearer the distal than the proximal tooth of the mobile finger. In a specimen measuring 111 mm. in total length, the following are the measurements of its large chelipedes :—

	i.	m.	c.	p.	f.
R. chelipede ..	25	33	67	40	23
L. chelipede ..	25	33	66	39	22.5

It is to be noted from the above measurements, that the carpus is longer than the propodus, and that the fingers are a little more than half the length of the palm.

The Mangalore specimens in our collection have comparatively longer and more slender chelipedes than those from Malabar.

The telson is broad towards the apex with a short median point. The inner sub-terminal spinule on each side projects beyond the tip of the telson by about half its length; the much shorter outer lateral spinule does not reach the tip.

Minute tubercles are present on the anterior surface of the carapace, the exposed dorsal surface of the last pair of abdominal appendages, the ventral surface of the exopodites of the same pair of legs, the telson and the sixth abdominal segment, and the ventral and posterior margins of the abdominal epimera, especially of the second, third and fourth segments. The presence and distribution of these tubercles are of specific value.

Characters of females.—The number of teeth on the almost straight upper margin of the rostrum varies within greater limits (11 to 15). The large chelipedes are slightly scabrous and are about two-thirds the body-length. A few setæ are irregularly distributed on the fingers which are otherwise naked. The palm is as wide as, or slightly wider than the distal end of the carpus. The following measurements are taken from the large chelipedes of an adult female measuring 89 mm. in total length :—

i. 12.5 m. 11 c. 20 p. 13 f. 11.

From the above measurements it will be seen that the carpus is slightly shorter than the propodus,¹ and the fingers longer than in the male. Adult females vary from 70 to 90 mm. in total length. The single female specimen (with eggs) from Mangalore measures 78 mm. and the joint-measurements of its right chelipede are as follows :—i. 12 m. 12 c. 21 p. 13 f. 8 mm. As in the case of the male specimens from the same locality, the chelipede of the female is relatively longer than that of female specimens from Malabar. The Mangalore examples might almost be regarded as constituting a distinct variety of *P. idæ*, but the differences are not sufficiently great in our opinion to entitle them to specific rank.

Characters of young individuals.—The proximal portion of the carpus is narrower than the palm, while its distal portion is as wide

¹ The reader is reminded that our initial letter p. stands for palm. The length of the propodus is obtained by adding the measurements recorded for p. and f.

as the latter. The following are the measurements of a young specimen measuring 72 mm. :—

	i.	m.	c.	p.	f.
R. chelipede ..	13·5	14·5	26	15	11
L. chelipede ..	13·5	14	24	14·5	10·5

General remarks.—On comparing this species with Heller's description and figures, we find that it agrees in a great many respects with *P. idæ*. The large chelipedes have the same general build, and the joints show almost the same relative lengths. The following differences, however, appear to exist:—Heller states that the inner margins of the fingers are toothless, and that the tooth-formula is $\frac{10 \text{ to } 11}{4 \text{ to } 5}$, while his figure shows the large chelipede to be stouter. Hilgendorf's figures based on specimens from Zanzibar which he refers to *P. idæ*, seem to agree with those of Heller except that the tooth-formula is $\frac{9}{3}$, and the chelipedes are even stouter than in Heller's figure.

Von Martens thinks it probable that *P. sundaicus*, Heller, from Java, in which the carpus is shorter than the propodus, is the young of *P. idæ*. Ortmann rejects von Martens' view on the assumption that the carpus, which, in the young, is already shorter than the propodus, can never, as a result of growth, exceed it in length; while this observation is true of most species of *Palaemon*, we have reason to believe that it does not apply to the present one. From observations carried out on a large number of specimens, we are able to state that the fingers in the present species elongate less rapidly with advancing age than do the merus and carpus, and the palm does not grow so quickly as it does in *P. carcinus* and *P. malcolmsonii*, with the result that in adult males the carpus is longer than the propodus. Our observations, therefore, seem to corroborate von Martens' supposition. Moreover young male individuals and females of the Indian species which we refer to *P. idæ*, agree closely with Heller's description and figures; his specimen, which was probably a female, measured 3 inches in length.

While Heller's account of *P. sundaicus* appears in his paper before that of *P. idæ*, the latter name is preferable, because the description is based on the characters of an adult male, while some uncertainty must attend the identification of the former based as the species is on a female specimen.

Nobili has referred to *P. sundaicus* a single specimen from Pondicherry, which measured 55 mm. in total length, with the rostral formula $\frac{11}{5}$.

P. lanceifrons, Dana, originally recorded from Manila, in which the carpus nearly equals the palm in length, is perhaps also the young of *P. idæ*, but in a slightly more advanced stage than

P. sundaicus. Ortmann, however, refers to *P. lanceifrons*, a specimen from Ceylon measuring 85 mm. in total length (Dana's original specimen measured only 55 mm.), in which the carpus and palm are sub-equal, and he argues as in the case of *P. sundaicus*, that the differences between the two examples in the relative lengths of the carpus, palm, and fingers, are accountable by the greater growth of the Ceylon specimen

The following measurements taken from the large chelipedes of male individuals show the changes which accompany growth in regard to their relative lengths:—

No.	Locality.	Total length of body.	LARGE CHELIPEDES.						
			Right or left.	Total length of chelipede.	Ischium.	Merus.	Carpus.	Palm.	Finger.
I	Mangalore	67	R			Missing.			
			L	108.5	14.5	19	37	24	14
II	Kottayam	72	R	80	13.5	14.5	26	15	11
			L	75.5	13.5	14	24	14.5	10.5
III	Mangalore	73	R		17.5	25.5	47		
			L	136.5	17.5	25.5	46.5	31	16
IV	Cochin ..	77	R	91.5	13.5	17	29	20	12
			L	71.5	12	14	21.5	15	9
V	,, ..	79	R	89	13.5	16	28	20	11.5
			L	84.75	13	15.25	27	18.5	11.5
VI	,, ..	88	R	134.5	18.5	24	47	28	17
			L	132.5	18.5	24	45	28	17
VII	,, ..	89	R	142	18.5	25	48	32.5	18
			L	145.5	18.5	26	49.5	33	18.5
VIII	Calicut ..	91	R	145	19	25	51.5	31	18.5
			L	139.5	19	24	48.5	30	18
IX	Trichur ..	103	R	196.5	25	34	71	44	22.5
			L	188.5	24.5	35	67	41	21
X	Palghat ..	104	R	184	23.5	33	61.5	46.5	19.5
			L	192.5	24	34.5	65	49	20
XI	Calicut ..	111	R	188	25	33	67	40	23
			L	185.5	25	33	66	39	22.5

It is to be noted from the above table that the two Mangalore specimens, though only 67 and 73 mm. in total length, yet possess adult characters and their chelipedes are relatively longer than those of the Malabar specimens. They may, therefore, be regarded as a smaller variety of *P. idæ*. Numbers IX and X, though with shorter body-length than No. XI, have longer chelipedes and in No. X, the propodus is slightly longer than the carpus. The latter was the only example out of a large number examined, of about the same size, which exhibited this peculiarity.

Localities.—Western India. Several specimens of both sexes from South Canara District (Mangalore), Malabar District (Calicut, Palghat), Cochin State (Koll Lands, Cochin), Travancore (Kottayam).

General Distribution.—*P. idæ* has been recorded from Madagascar (Coutière), Zanzibar (Hilgendorf), Dar-es-Salaam (Ortmann), Seychelles and Mauritius (Richters), Ceylon (Heller), Singapore (von Martens), Sumatra (Nobili), Java (von Martens, de Man, Thallwitz), New Guinea (Nobili), Borneo (Heller), and the Philippines (von Martens, Thallwitz). It is recorded from the sea at Java by de Man.

P. sundaicus has been met with in the following localities:—Madagascar (Coutière), Natal, in the sea (Max Weber), Mozambique (Hilgendorf), Zanzibar (Grandidier), Java (Heller, de Man), Flores and Celebes (de Man).

PALAEEMON SULCATUS, n. sp.

(Pl. xvi, figs. 4a—g.)

We refer six specimens from Cochin to this new species, of which one is a female and the rest males. Though possessing some points in common with *P. idæ*, they can yet be distinguished from the latter by certain well-marked differences.

Characters of adult males.—In the largest specimen measuring 93 mm. and in another measuring 84 mm. in total length, the rostrum shows some resemblance to that of *P. idæ*, but the proximal portion of the upper margin is only very slightly convex, and the rostrum extends nearly as far as the distal margin of the antennal squame, with the tooth-formula $\frac{12}{6}$ and $\frac{12}{4}$ respectively. In a third specimen measuring 79 mm. the upper margin is almost straight with the tooth-formula $\frac{11}{4}$; in the fourth specimen measuring 82 mm. the proximal portion is straight, but the distal portion is turned up, with the formula $\frac{11}{4}$; in the fifth specimen, the rostrum extends beyond the distal margin of the squame, and is considerably upturned distally, the three distal teeth are very close to each other, the fourth and fifth teeth are separated by a much wider

gap than the others, and the dental formula is $\frac{12}{5}$. In all these specimens the first and second upper teeth, as in *P. idæ*, are separated by a wider interval than the others, and the two distal teeth are usually situated close to each other; the teeth are stronger and are placed further apart than in *P. idæ*; the first three upper teeth are on the carapace.

The large chelipedes are sub-cylindrical and sub-equal, but in the largest specimen they are unequal, the right one being longer than the left. The palm is as wide as, or slightly narrower than, the distal end of the carpus. The fingers are of equal thickness and their tips are incurved, while the tooth on the immobile finger is acute; in these respects they resemble *P. idæ*. The upper surface of the chelipedes, with the exception of the fingers, is beset with very short and slender forwardly directed spinules, while the rest of the surface is provided with fewer but stronger spinules slightly directed forwards, which are best developed on the lower surface; the longitudinal arrangement of the spinules is specially marked in the present species. A lateral groove free of spinules runs along the outer side of the merus, carpus and palm, being most distinct on the carpus. The characteristic linear arrangement of these spinules and the presence of a lateral groove on the chelipedes are very characteristic of the present species; the specific name is taken from the last mentioned peculiarity. It may be noted that a similar groove is present in *P. lar*, Fabr. A dark brown mottling occurs on the chelipedes more particularly on the fingers. From the largest specimen measuring 93 mm. in total length, the following measurements were obtained:—

Long chelipede (right).

i. 18 m. 25 c. 48 p. 44 f. 22.

Short chelipede.

i. 14 m. 20 c. 29 p. 22 f. 12.

It should be noticed from the above that the longer chelipede is more than one and a half times the length of the body, while the shorter one nearly equals it, and that the carpus is shorter than the propodus, but longer than the palm, while in *P. idæ* the carpus is longer than the propodus.

As in *P. idæ* the inner sub-terminal spinules on the telson project beyond the tip of the latter by about half their length; the much shorter outer lateral spinule does not reach the tip.

The anterior surface of the carapace, the exposed upper surface of the last pair of abdominal appendages, and the lower margins of the abdominal epimera are scabrous. The upper surface of the telson is provided with close-set spinules, similar to those on the large chelipedes.

Characters of the female.—It measures 71 mm. in total length. The rostrum has an almost straight upper margin, and extends a

little beyond the antennal squame; the tooth-formula is $\frac{11}{4}$. The large chelipedes are practically equal, and much shorter than the body; the spinules are weaker than in males, but retain the same characteristic arrangement. The lateral groove is well seen on the carpus, but it tends to assume a more dorsal position; whether this is characteristic of all females cannot be determined as there is only a single specimen in the collection. The pubescence on the fingers is similar to that in males but feebler. The joint-measurements of the chelipedes are as follows:—

i. 8 m. 9 c. 12 p. 10 f. 6.5.

The entire surface excepting the chelipedes is smooth, but the telson is slightly rough. The following are detailed measurements of all six specimens:—

Length of—	♂		♂		♂		♂		♀	
body	79		82		82		84		93	
	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.
chelipedes	83	86.5	94.5	94	96.5	96	107.5	97	157	97
ischium	12	12	14	13	14	15	14	13.5	18	14
merus	14.5	14.5	16.5	16.5	18	17	18	17.5	25	20
carpus	23.5	24.5	26	26	29.5	28	29.5	28	48	29
palm	21	22.5	24	24.5	21	20.5	29	24	44	22
fingers	12	13	14	14	14	15.5	17	14	22	12
									6.5	6.5

Locality.—We have obtained this species only from Cochin.

PALAEMON RUDIS, Heller.

(Pl. xvii, figs. 5a—h.)

P. rudis, Heller, Verh. Z. B. Gesellsch. Wien, p. 527 (1862); Ortmann, l.c., p. 741 (1891); Coutière, Ann. des Sci. Nat. Sér. 8, t. xii, p. 288 (1901).

P. mossambicus, Hilgendorf, Monatsb. Akad. Wiss. Berlin, p. 839, tab. iv, fig. 17 (1878).

P. alcocki, Nobili, l.c., p. 9, fig. 5 (1903).

Characters of adult males.—The rostrum which shows a moderate proximal convexity extends as far as the distal margin of the antennal squame, or a little behind it; the distal portion slopes slightly downwards; the tooth-formula is $\frac{10-12}{4}$. The first two

teeth, as in *P. idæ*, are on the carapace, and are separated by a wider interval than any of the others; as a rule the two distal teeth are closer together than any of the others.

The large chelipedes are always unequal; the longer chelipede is a little less than one-and-a-half times the length of the body; the shorter chelipede is about five-sixths the length of the longer one. The chelipedes are everywhere pubescent, but this characteristic is less marked on the ischium, and most pronounced on the opposed margins of the fingers. The palm is practically cylindrical, and is the same width as the distal end of the carpus, or sometimes slightly narrower. The fingers are of equal thick-

ness; as in *P. idæ* and *P. sulcatus*, the tooth on the immobile finger is acute and the proximal tooth on the mobile finger is smaller than the distal one; when the fingers are closed the first of these teeth fits between the other two; the crenation of the ridge of the immobile finger, proximal to its basal tooth, is more prominent than in *P. idæ* and *P. sulcatus*. A row of from 15 to 20 tubercles exists on each side of the median ridge of both fingers, and is exposed on removal of the pubescence; sometimes it is found only on one side of the ridge; this character and the pubescence on the chelipedes are distinctive of the present species. The following measurements are taken from the large chelipedes of a specimen measuring 117 mm. in total length:—

Total length	i.	m.	c.	p.	f.
185	20	35	55	40	35
169	18	32	50	40	29

From the above measurements it will be seen that the joints of both chelipedes have about the same relative lengths, but unlike *P. idæ* the carpus is shorter than the propodus and the fingers are relatively longer.

The telson is similar to that of *P. idæ*, the inner sub-terminal spinule on each side projecting beyond the tip of the telson by about half its length; the much shorter outer lateral spinule does not reach the tip.

The carapace is slightly scabrous anteriorly; the rest of the body is merely punctate.

Characters of females.—The rostrum is slightly longer than that of the male; it may extend as far as, or slightly beyond, the distal margin of the antennal squame.

The large chelipedes are punctate, sub-equal, and about two-thirds the length of the body. The tubercles on each side of the finger-ridges are poorly developed or even absent. The middle of the palm is sometimes wider than the extremities, in which case it is wider than the distal portion of the carpus. In a specimen measuring 86 mm. in total length, the joint-measurements are as follows:—

i. 9	m. 10.5	c. 16	p. 10	f. 9.
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The females of the present species may easily be mistaken for those of *P. idæ*, but the rostrum differs from that of the latter species in possessing a moderate proximal convexity. In *P. idæ* the proximal portion is very slightly convex or even almost straight. The upper rostral teeth are also larger and placed further apart than in *P. idæ*.

Characters of the young.—The rostrum is sometimes upturned distally as in *P. idæ*; it may extend a little beyond the distal margin of the antennal squame as in females. The proximal portion of the carpus is extremely slender. The proximal portion of the palm is as wide as the distal portion of the carpus. The palm widens towards its middle, so that its inner surface

appears almost convex. This characteristic persists even in certain large males; it is specially marked in young individuals from Cocanada. The tubercles on each side of the finger ridges, so characteristic of adults, are absent in the young. In a specimen measuring 82 mm. the chelipedes are practically equal, and their joint-measurements are as follows:—

i. 9 m. 10 c. 16 p. 10 f. 9.

With advancing age, the chelipedes become unequal in length, the tubercles on the fingers make their appearance, and the pubescence appears more fully developed.

General remarks.—Nobili has described under the name of *P. alcocki* a freshwater prawn from Pondicherry, of which he was able to examine only a single specimen measuring 57 mm. in total length and obviously immature. In it the tooth-formula is $\frac{9}{4}$; the two upper distal teeth are placed near the tip and two teeth are situated on the carapace. The nature and arrangement of the teeth are the same as in the species just described, but we have not yet met with a specimen showing only 9 upper rostral teeth, although we have examined a considerable number. Nobili's figure of the rostrum shows the upper margin to be straight, while in the present species the proximal portion is generally slightly convex. The large chelipede, a figure of which is also given by Nobili, greatly resembles that of young individuals of our species both in shape and in the relative lengths of the joints. Nobili lays stress on the dilatation of the palm in *P. alcocki*, and certain young individuals from Cocanada which we refer to *P. rudis* agree in this respect.

The following is a comparison of the joint-measurements in one of our young specimens measuring 58 mm., and those recorded by Nobili in his single specimen which measured 57 mm. in total length:—

	i.	m.	c.	p.	f.
Our specimen ..	6	7	10·5	6	5·5
Nobili's specimen		7	12	6·5	7·5

While, therefore, it is not unlikely that Nobili's species was based on a young specimen of the one which we have just described from examples at different stages of growth, it is impossible to decide the matter definitely, because young individuals of many species of *Palaemon* closely resemble one another.

The joint-measurements of the large chelipedes of specimens at various stages of growth are given on page 294.

No.	Locality.	LONG CHELPEDE.						SHORT CHELPEDE.				Total length of body.	Total length of long che-lipede.	Total length of short che-lipede.
		Right or left.	Ischium.	Merus.	Carpus.	Palm.	Finger.	Ischium.	Merus.	Carpus.	Palm.	Finger.		
I	Cocanada ..	R ..	10	11	17	13.5	13	9	10.5	15	12	11.5	74	64.5
II	" ..	L ..	10.5	14.5	21.5	18	14.5	10	13.5	20	16	14	79	73.5
III	" ..	L ..	10.5	13	20.5	15.5	13	10.5	12.5	19.5	14.5	12.5	83	69.5
IV	" ..	L ..	16	28	44	32.5	25.5	13	17	30	20	14.5	92	94.5
V	Madras (Otary)	R ..	11	13	21	14	13	11	12	19	12.5	11.5	94	72
VI	" ..	R ..	13	20	31.5	21.5	18.5	12.5	18.5	28	18	16	98	104.5
VII	" ..	L ..	12	16	26.5	18.5	16	11.5	15.5	24.5	17	15.5	99	89
VIII	" ..	L ..	12.5	16	24.5	17	14.5	12	14.5	22	14	12.5	101	84.5
IX	Madras (Vysarapadi)	L ..	14	18.5	29	21.5	17	13	16.5	26	17.5	14	102	100
X	" ..	R ..	19	32	52.5	40	31.5	17.5	30	48	35	27	111	175
XI	" ..	R ..	20	35	55	40	35	18	32	50	40	29	117	185

Localities.—A large number of males and females from Madras; several males from Cocanada.

General distribution.—*P. rudis* has been recorded from Madagascar (Coutière), Mozambique (Hilgendorf), East Africa (Pfeffer), and Ceylon (Heller).

PALAEEMON NOBILII, n. sp.

(Pl. xvii, figs. 6a—e.)

We include in this species two specimens from Walajabad, Chingleput District, a male and a female, the latter bearing eggs, which differ greatly from all the other Indian species which we have examined.

Characters of the male.—The single specimen measuring 64 mm. in total length is well developed and apparently possesses adult characters. The rostrum tapers somewhat abruptly towards the acute tip, and extends slightly in front of the antennular stalk; the dental formula is $\frac{12}{2}$. The part of the upper rostral margin on which the fourth to the tenth teeth are situated is convex, and the apex forms an acute slightly upturned tooth. The first five upper teeth are on the carapace, and of these the first four are separated by wider intervals than the others; the last tooth is placed a little distance from the apex.

The large chelipedes are sub-cylindrical, and unequal, the left one longer than the right. In the former, the palm is slightly compressed dorso-ventrally, and is as wide as the distal end of the carpus; the finger-tips are abruptly incurved. The distal tooth on the mobile finger is a little behind the middle of the joint, and is smaller than the proximal tooth; the tooth on the immobile finger is about the same size as the distal tooth on the mobile finger. The chelipedes are provided with numerous forwardly directed spinules; those on the under surface being fewer but more strongly developed than those on the upper surface. The teeth on the median ridges of the fingers of the short chelipede are weaker, and the opposed margins are provided with more numerous setæ; in other respects the short chelipede is similar to the longer one. The joint-measurements are as follows:—

	Total length	i.	m.	c.	p.	f.
R. chelipede	.. 56	8.5	11	14.5	15	7
L. chelipede	.. 70.75	10.75	13.75	19.5	18.75	8

It should be noticed from the above measurements, that the fingers are shorter than half the length of the palm, and that in the longer chelipede, the carpus is much longer than the merus.

The telson-tip is not so acute as in *P. carcinus* and *P. malcolmsonii*; the inner lateral spinules extend beyond the tip by a little less than half their length; the outer spinules are very short;

the setæ at the tip of the telson exceed the lateral spinules in total length. The body is smooth.

Characters of the female.—It measures 54.5 mm. in total length. The distal portion of the upper margin of the rostrum is almost straight, and extends only as far as the tip of the antennular stalk.

The tooth-formula is $\frac{10}{2}$; the first four upper teeth are on the carapace, while the first three are separated by wider intervals than the others. The large chelipedes are sub-equal, and are very slightly scabrous; the teeth on the immobile finger are absent, while the one on the mobile finger is poorly developed. The joint measurements are as follows:—

	Total length	i.	m.	c.	p.	f.
R. chelipede ..	38.5	7	7.5	10	8	6
L. chelipede ..	41.5	7	8	11	9.5	6

In some respects, this species resembles *P. altifrons*, Henderson, recorded from Delhi, the River Jumna and Lahore, but in the latter the carpus is a little shorter than the merus, and the fingers are more than half the length of the palm and are smooth above and below.

We have associated this species with the name of the Italian naturalist Nobili, by whose untimely death science has been deprived of an indefatigable worker, more particularly in the field of carcinology. While the genus *Palaemon* was established by Fabricius more than a century ago, from South Indian specimens, Nobili was the first to describe any of these in detail.

P. SCABRICULUS, Heller.

(Pls. xvii, figs. 7a—c, and xviii, figs. 7a—b.)

P. scabriculus, Heller, Verh. Zool.-Botan. Ges. Wien, p. 527 (1862); *Id.*, "Novara" Crust., p. 117, taf. x, fig. 9 (1865); Ortman, Zool. Jahrb. Syst., Bd. v, p. 710 (1891); de Man, in Max Weber's Zool. Ergebn., p. 462, taf. xxvii, fig. 41 (1892); Henderson, Trans. Linn. Soc. Zool. ser. 2, vol. v, p. 442 (1892); Nobili, Boll. Mus. Zool. di Torino, vol. xviii, n. 452, p. 12 (1903).

Characters of adult males.—The rostrum admits of great variation in length and shape; it generally extends as far as the tip of the antennular stalk, but in some cases may fall short of this, while in others it extends slightly beyond; its depth in relation to its length is not very definite. The upper margin of the rostrum also varies considerably in the amount of its convexity; in some examples this margin is practically straight. The tooth-formula is $\frac{12 \text{ to } 15}{2 \text{ to } 3}$, the upper teeth being placed very near each other; the first three or four are wider apart than the others, and the first four or five are on the carapace; thickly-set setæ are present between the teeth.

The large chelipedes are stout and always unequal in length; the longer chelipede which may be either the right or the left is much stouter than the shorter one; they are well provided with long setose hairs. The upper surface of all the joints is roughened by minute close-set spinules, which are best developed on the carpus, while those on the under surface are fewer, but somewhat better developed and more erect; only a few spinules occur on the basis while in the longer chelipede those on the palm are confined to its proximal upper surface. Traversing the dorsal surface of the carpus is a longitudinal groove proceeding from the upper protuberance or knob on the inner side of its distal end; this groove is, however, very faint in some specimens and in a few it is absent. The following are the chief characters of the longer and larger chelipede. The setose hairs on the palm and basal regions of the fingers are matted together to form a velvety covering. The lateral groove on the outer surface of the ischium which is generally present in other freshwater prawns is very faint or even absent here, while that on the inner surface is specially deep. The two inner knobs generally present on the distal end of the carpus are specially prominent in this species, and the groove between them is very deep. The palm is compressed dorso-ventrally; its length in relation to its width varies from about two to one to about three to one; it is wider than the distal end of the carpus. The fingers are of nearly equal thickness; the immobile finger is slightly concave internally and the mobile one has almost the same curve; the tip of the mobile finger is more strongly incurved than that of the immobile one, so that when the fingers are closed it crosses the immobile finger at a short distance from the tip. There is a row of from 17 to 26 tubercles on the median ridge of the mobile finger, and from 12 to 20 on the immobile finger; these tubercles gradually decrease in size towards the distal end; the third or fourth tubercle of the mobile finger is the largest and the basal tooth of the immobile finger fits in behind it. When the fingers are closed their opposed margins do not meet. There is great variation in the relative lengths of the joints; the carpus is generally shorter than the merus, but in some cases it is equal to or even slightly longer than the latter; the palm is longer than the carpus; the fingers are usually much shorter than the palm, but in some cases, they are either equal to it or even slightly longer. The larger chelipede is longer than the body. The smaller chelipede differs from the larger one in the following respects:—The palm is as wide as the distal end of the carpus, and the setose hairs with which it is provided are not matted together. The fingers are equal, and their tips are very slightly incurved; the tubercles on their ridges are poorly developed towards the distal end, and in some cases are totally absent; when closed their margins meet. The palm is generally sub-equal to the carpus, sometimes even shorter; the fingers are always longer than the palm. The shorter chelipedes is shorter than the body.

A table of measurements of the chelipedes in a number of specimens which present adult characters is given on page 299 to show the variation in the relative lengths of the joints.

The tip of the telson is variable; it may be either broadly pointed or rounded. The terminal median spine is short and blunt, and the inner lateral spinules project beyond it by about half or two-thirds of their length; long setæ are present at the tip, and extend much beyond the inner lateral spinules.

The antero-lateral regions of the carapace are scabrous; the walking legs are also scabrous and setose; the setæ present on the free margins of the abdominal epimera and caudal fin are longer than in any of the preceding species.

Characters of females.—The rostrum is usually deeper than in males, and extends beyond the antennular stalk, but not so far as the distal margin of the antennal squame. The large chelipedes are equal or sub-equal, and their length is about half that of the body; they are sparingly setose. The palm is only slightly compressed; the fingers are equal, their median ridges are feebly indented and definite tubercles can scarcely be said to exist. The body is practically smooth. Females with eggs (which are very small in this species) vary from 53 mm. to 40 mm. in total length. In one of them measuring 49 mm. the joint-measurements are as follows:—

i. 5 m. 6 c. 6 p. 5 f. 5.

Characters of the young.—The chelipedes are of equal length in very young males, which shows that with growth one of the chelipedes increases more quickly in length, and assumes the characteristics of the larger chelipede of the adult, while the other grows more slowly. In a specimen measuring 42 mm. in total length, the joint-measurements are as follows:—

i. 4 m. 5 c. 5 p. 5 f. 4.5.

Colours when fresh.—In large males a median pale band runs along the dorsal surface from the tip of the telson to the rostrum; this is continued along the upper half of the rostrum to its tip. On the abdomen this band is incompletely divided by a median discontinuous greyish streak. The fingers of the shorter chelipede, with the exception of the extreme tips, are dark-blue.

The fingers in the female are encircled by two blue bands; the extreme tips are white. The last pair of abdominal appendages are violet above and below, but their outer borders are white.

Localities.—A large series from Madras, Red Hills, and Walajabad; Trichinopoly; Palghat; Calicut; and Tanjore District.

General distribution.—*P. scabriculus* is recorded from Ceylon (Heller), Saleyer and Celebes (de Man). It has been previously met with in the following Indian localities:—Kotri on the River Indus (Henderson), and Pondicherry (Nobili).

No.	Locality.	Right or left.	LONG CHELPEDE.						SHORT CHELPEDE.					Total length of long che-lipede.	Total length of short chelipede.
			Ischium.	Merus.	Carpus.	Palm.	Mobile finger.	Immobile finger.	Ischium.	Merus.	Carpus.	Palm.	Finger.		
I	Trichinopoly ..	L	8	13	13	17	18	19	8	10.5	10.5	10	12	61	51
II	Madras ..	L	7.5	14	13.5	20	20	20.75	7	10	9	7.5	10.5	62	44
III	Walajabad ..	R	8	6.25	15	26	20.5	20.75	7.5	12	11	10	11.5	66	52
IV	Saidapet ..	R	8	16	14.5	25	20	20.75	7.25	11.5	10	10	11.25	68	50
V	Trichinopoly ..	R	8	17	15	25	22.5	24	8	12	11	10	12	71	53
VI	Oothucadu (Tanjore Dt.)	L	9.5	19	16	24.5	23.5	24.5	8	13	11.5	11.5	12.5	75	50.5
VII	Trichinopoly ..	L	9.5	17	18	26.5	27	28.5	8	12	14	11	16	70	61
VIII	" ..	L	10	20	18	30	24	25	9	14.5	13	14.5	15	85	66
IX	" ..	R	11	22.5	19	38	28	30	10	16	14	15	17	88	72

P. DOLICHODACTYLUS, Hilgendorf.

(Pl. xviii, figs. 8a—b.)

P. dolichodactylus, Hilgendorf, Monatsb. Akad. Wiss. Berlin, p. 840, taf. iv, fig. 18 (1878); Ortman, l.c., p. 731 (1891); Coutière, Ann. Sci. Nat. Zool. t. xii, p. 283 (1901); Nobili, l.c., p. 13 (1903).

Characters of adult males.—The only points of difference that we have been able to discover between this so-called species and the last are as follows:—The carpus of the longer chelipede is usually longer than the merus; the palm is never wider than the distal end of the carpus, and in most cases is of the same width. The fingers are thinner than those of *P. scabriculus* and are much longer than the palm; the velvety covering on the latter joint is continued to the proximal halves of the fingers. The median ridges bear more tubercles than in *P. scabriculus*, 25 to 32 on the mobile finger and 23 to 25 on the immobile; when closed the opposed margins of the fingers meet.

A table of measurements of the large chelipedes in some specimens which appear to be adult is given on page 303.

We have a male prawn from the Nilambur forest, measuring 64 mm. in total length, which seems to connect *P. scabriculus* and *P. dolichodactylus*. The carpus and merus are of equal length, and the palm is a little longer than the fingers. The fingers are subequal and the velvety covering on the palm is continued on them for only one-third of their length; their opposed margins meet when closed. The mobile finger bears 22 tubercles, and the immobile one 17 in addition to the basal tooth. The joint measurements are as follows:—

		i.	m.	c.	p.	m.f.	im.f.
Long chelipede	..	8	15	15	26.5	24.5	25
Short	„	7	10.5	10.5	8	12.5	12.5

This specimen bears considerable resemblance to *P. petersii*, Hilgendorf, from East Africa (Monatsb. Akad. Wiss. Berlin, p. 841, taf. iv, fig. 19, 1878), and we are led to think that *P. petersii* is perhaps only a connecting link between *P. scabriculus* and *P. dolichodactylus*.

Localities.—Many specimens from a river in the Nilambur forest in the Malabar district; an adult male from Palghat; Madras; Walajabad.

General distribution.—*P. dolichodactylus* has been recorded from the East coast of Africa, from Natal to Mozambique (Hilgendorf), Madagascar (Coutière). Nobili records it from Pondicherry.

P. DUBIUS, n. sp.

(Pl. xviii, figs. 9a—d.)

Characters of adult males.—Again in this form we shall content ourselves by merely indicating the points of difference between it

and the two preceding. The chelipedes are much weaker than in *P. scabriculus* and *P. dolichodactylus*, while the longer chelipede is a little shorter than the body. The setose hairs on the chelipedes are short and few; those on the palm and bases of the fingers are comparatively sparse, so that the joints appear almost naked. The spinules on the chelipedes are feebly developed. The carpus is always shorter than the merus. The palm is not so strongly compressed as in *P. scabriculus* and *P. dolichodactylus*, with the result that it is much longer than broad, the proportion being four to one; it is wider than the distal end of the carpus, and much longer than the fingers. The fingers which are equal are considerably thinner and their tips are much less strongly incurved than in the other two species; the tubercles on the fingers are considerably smaller and fewer: there being only from 12 to 18 on the mobile finger and 11 to 15 on the immobile.

The measurements given on page 304 are taken from the large chelipedes of certain individuals which we regard as adult.

It will be seen from the measurements that there is less variation in the joint-lengths of the chelipedes in the present form than in *P. scabriculus* and *P. dolichodactylus*.

We give on page 305 the joint measurements of three specimens which we are unable to satisfactorily assign to one or other form but which appear to connect *P. scabriculus* and *P. dubius*.

Colours when fresh.—In the males of *P. dubius* there is a median dorsal pale band as in *P. scabriculus*. The fingers of the shorter chelipede are doubly banded with blue as in the females of *P. scabriculus*; those of the larger chelipede are dark blue, with the extreme tips almost white.

Localities.—A large series from Walajabad, Saidapet and other localities in the Chingleput District.

Note.—Though we have allowed the last three forms to remain distinct, the following considerations strongly incline us to the view that they may all belong to one and the same species. Adult males of *P. scabriculus* and *P. dolichodactylus* were found living together at Walajabad, Red Hills and Saidapet, and all three forms were obtained from the same tanks at Palghat and Walajabad, while young males obtained along with them were all alike. All the female specimens collected under the same conditions were also identical. Finally we possess specimens which we are forced to regard as connecting links between the three types of male.

ADDENDUM.

Since the previous pages were written we have received from Villivakkam, a village in the neighbourhood of Madras, an addition to our list in the species which de Man, from an examination of Bengal specimens (*Records, Indian Museum*, vol. ii, part 3, p. 222, 1908), has identified as *P. lamarrei*, Milne-Edw. Many of the specimens are females with ova, measuring from 40 mm. to 45 mm. in total length, and the eggs, which are unusually large

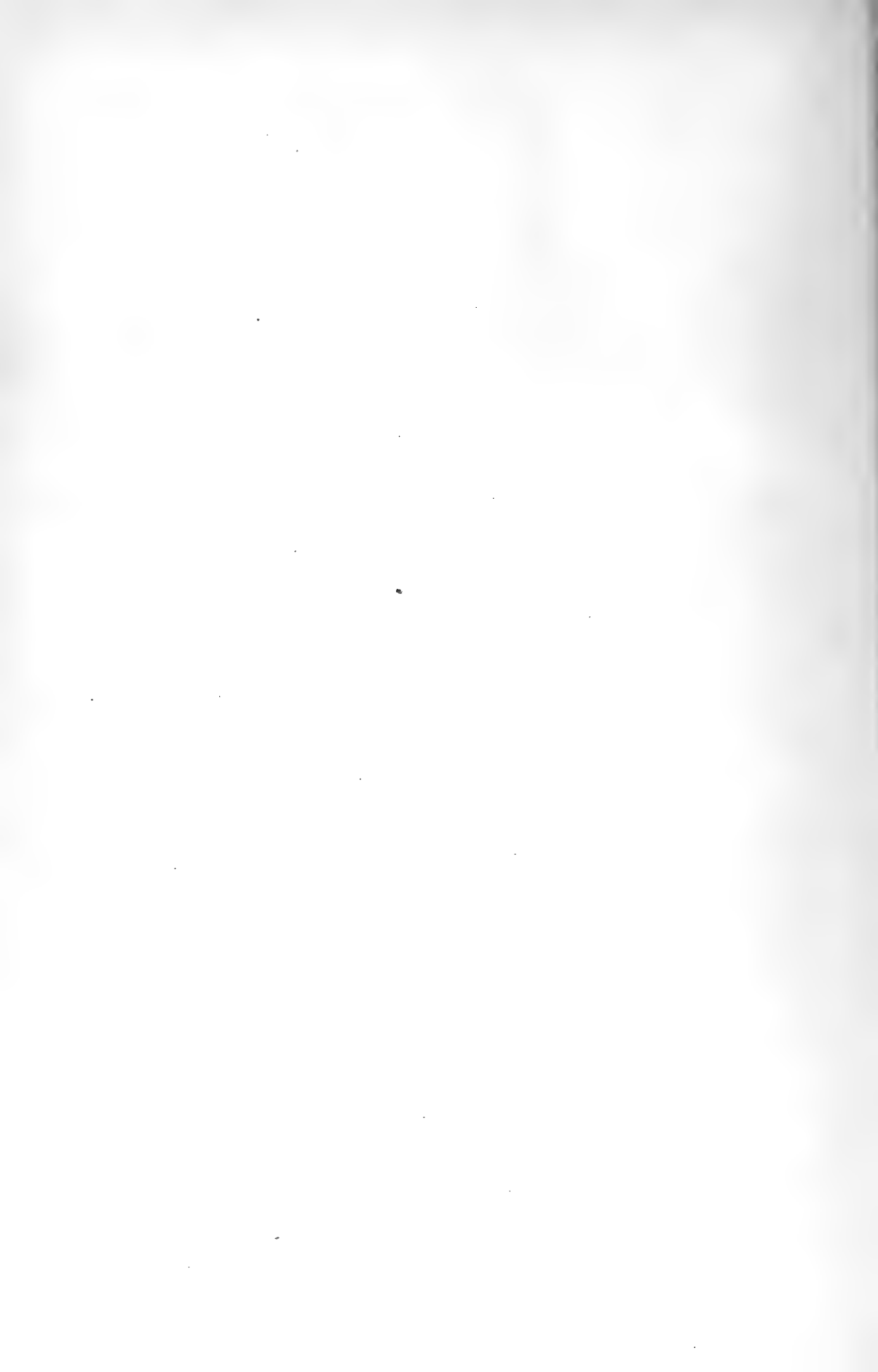
for such a small species, measure approximately 1.75 mm. in length and .75 mm. in breadth.

We succeeded in hatching out a number of the eggs, and ascertained that development is direct in *P. lamarrei*, the young prawn entering upon its free life with the full complement of thoracic and abdominal appendages, except the last pair of the latter, and the abdominal appendages are uniramous. A similar abbreviated metamorphosis was long ago observed by Fritz Müller in the case of *P. potiuna* (*Zool. Anzeig.* Jahrg. iii, 1880).

No.	Locality.	LONG CHELPEDE.?						SHORT CHELPEDE.					Total length of long che- lipede.	Total length of short che- lipede.
		Right or left.	Ischium.	Merus.	Carpus.	Palm.	Mobile finger.	Immobile finger.	Ischium.	Merus.	Carpus.	Palm.	Finger.	
I	River in Nilambur forest, Malabar.	R	8	14	16	16	26	25	7	10.5	11.5	8	13	50
II	" "	R	7	10	11	10.5	17	17	6	7	7.5	6.25	9	35.75
III	" "	L	8	15	16.5	18	28	28	7	10	11.5	8.5	14	51
IV	" "	L	8	15	17	19	broken	27	7	11	12.5	10	16	67
V	Walajabad	L	9	17.5	17	22	26	27	7	13	12	13	13.5	58.5
VI	Palghat	L	9	16.5	17.5	23.5	27.5	27.5	8.5	12	14	11	16	61.5
VII	" "	L	10	18	20	21	33.5	35	8.5	14	15	12	17	66

No.	Locality.	LONG CHELPEDE.					SHORT CHELPEDE.					Total length of long che- lipede.	Total length of short chelipede.		
		Right or left.	Ischium.	Merus.	Carpus.	Palm.	Finger.	Ischium.	Merus.	Carpus.	Palm.			Finger.	
I	Red Hills	..	R	6	10	8.5	13.5	9.5	6	8	7.5	7.5	62	47.5	36.5
II	Saidapet	..	L	6.5	10	9.5	12.5	10	6.25	8.5	7.75	7.25	63	48.5	37.75
III	"	..	L	7	11	11	15.5	12.5	6.5	8.5	8	8.5	66	57	39.5
IV	"	..	L	7.25	12	10.25	17.5	11.5	6.5	9	8	8.25	67	58.5	40.25
V	Walajabad	..	R	7	12	11	17.5	12.5	6.5	9.5	8.5	9	71	60	42
VI	"	..	L	8	14	12.5	21	15	7	10.5	9.5	10	73	70.5	47
VII	Saidapet	..	R	7.5	14.5	13.5	23	15	7.25	10.5	10	9.25	75	73.5	47

No.	Locality.	LONG CHELPEDE.						SHORT CHELPEDE.						Total length of long che- lipede.	Total length of short chelipede.	
		Right or left.	Ischium.	Merus.	Carpus.	Palm.	Immobile finger.	Ischium.	Merus.	Carpus.	Palm.	Immobile finger.				
I	Madras	..	R	5	8	7.5	9.5	8.5	5	7	6	5	6	53	38.5	29
II	Palghat	..	R	6.5	9.5	10	12	11	6.5	8	8.5	7	7.5	61.5	48.5	37.5
III	"	..	L	7.5	12	12.5	18	15.5	7	9	9.5	8	9.5	70.5	65.5	42.5



EXPLANATION OF PLATE XV.

FIG. 1.—*Palaemon carcinus*, Fabr.

„ 1a.—Cephalic region, $\frac{3}{4}$ nat. size (σ measuring 295 mm.).

„ 1b.—Cephalic region, $\frac{3}{4}$ nat. size (φ measuring 232 mm.).

„ 1c.—Right chelipede, nearly $\frac{3}{8}$ nat. size (σ measuring 295 mm.).

„ 1d.—Right chelipede, nearly $\frac{3}{4}$ nat. size (φ measuring 232 mm.).

„ 1e.—Right chelipede of young, nat. size (σ measuring 139 mm.).

„ 1f.—Caudal fin, nat. size (σ measuring 174 mm.).

„ 1g.—Apex of telson $\times 3$ (σ measuring 174 mm.).

FIG. 2.—*Palaemon malcolmsonii*, Milne-Edw.

„ 2a.—Cephalic region, nat. size (σ measuring 191 mm.).

„ 2b.—Cephalic region, nat. size (φ measuring 118 mm.).

„ 2c.—Cephalic region, nat. size (σ measuring 87 mm.).

„ 2d.—Right chelipede, $\frac{1}{2}$ nat. size (σ measuring 191 mm.).

„ 2e.—Right chelipede, nat. size (φ measuring 118 mm.).

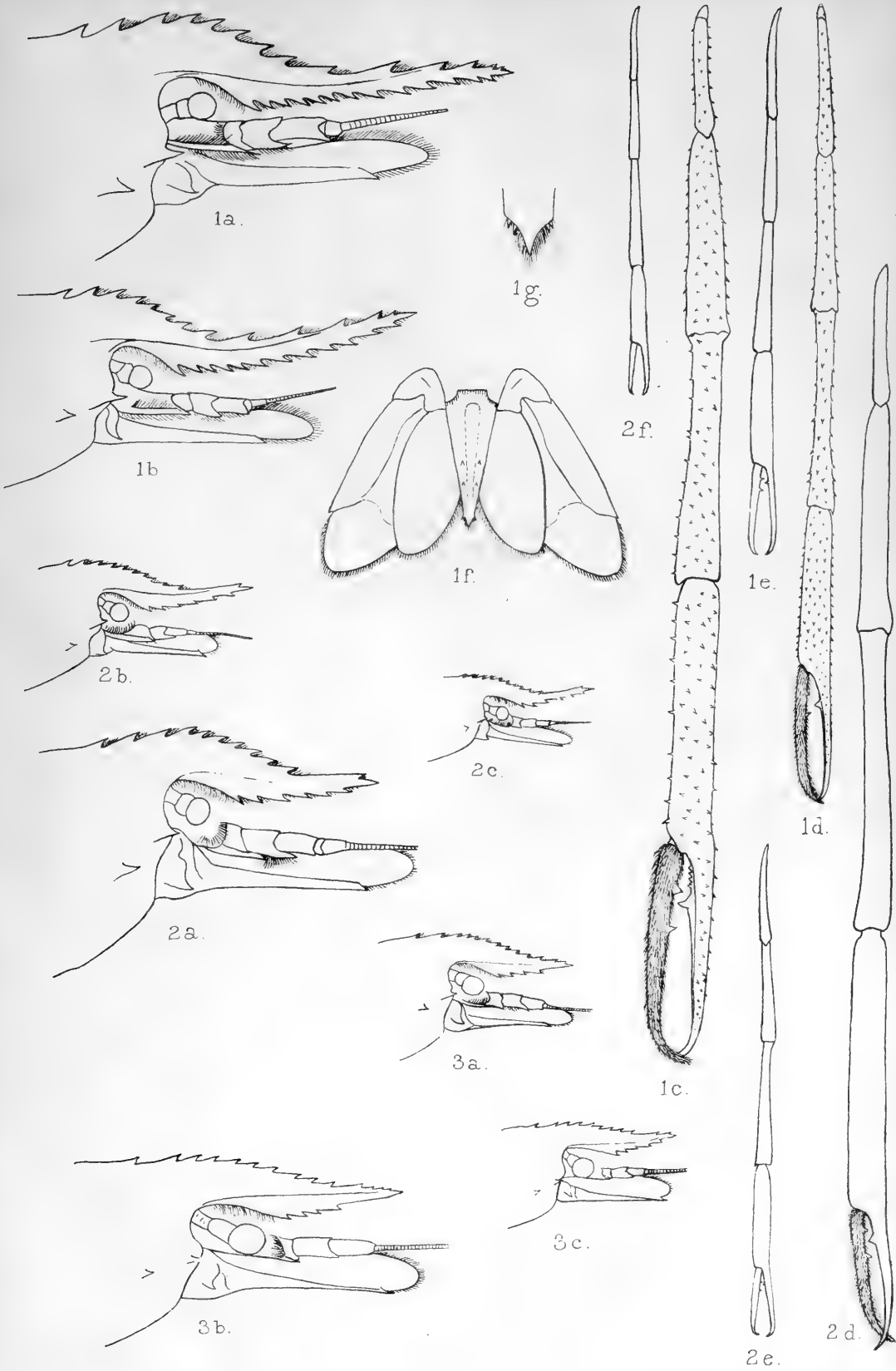
„ 2f.—Right chelipede, nat. size (σ measuring 86 mm.).

FIG. 3.—*Palaemon idæ*, Heller.

„ 3a.—Cephalic region, nat. size (σ measuring 110 mm.).

„ 3b.—Cephalic region, with the four terminal upper rostral teeth close together $\times 2$.

„ 3c.—Cephalic region of φ , nat. size.



1a-g. *Palaemon carcinus*, Fabr. 2a-f. *Palaemon malcolmsonii*, Milne-Edw
3a-c. *Palaemon idae*, Heller.

G.M. del.

Lith by, A.C. Chowdhary.



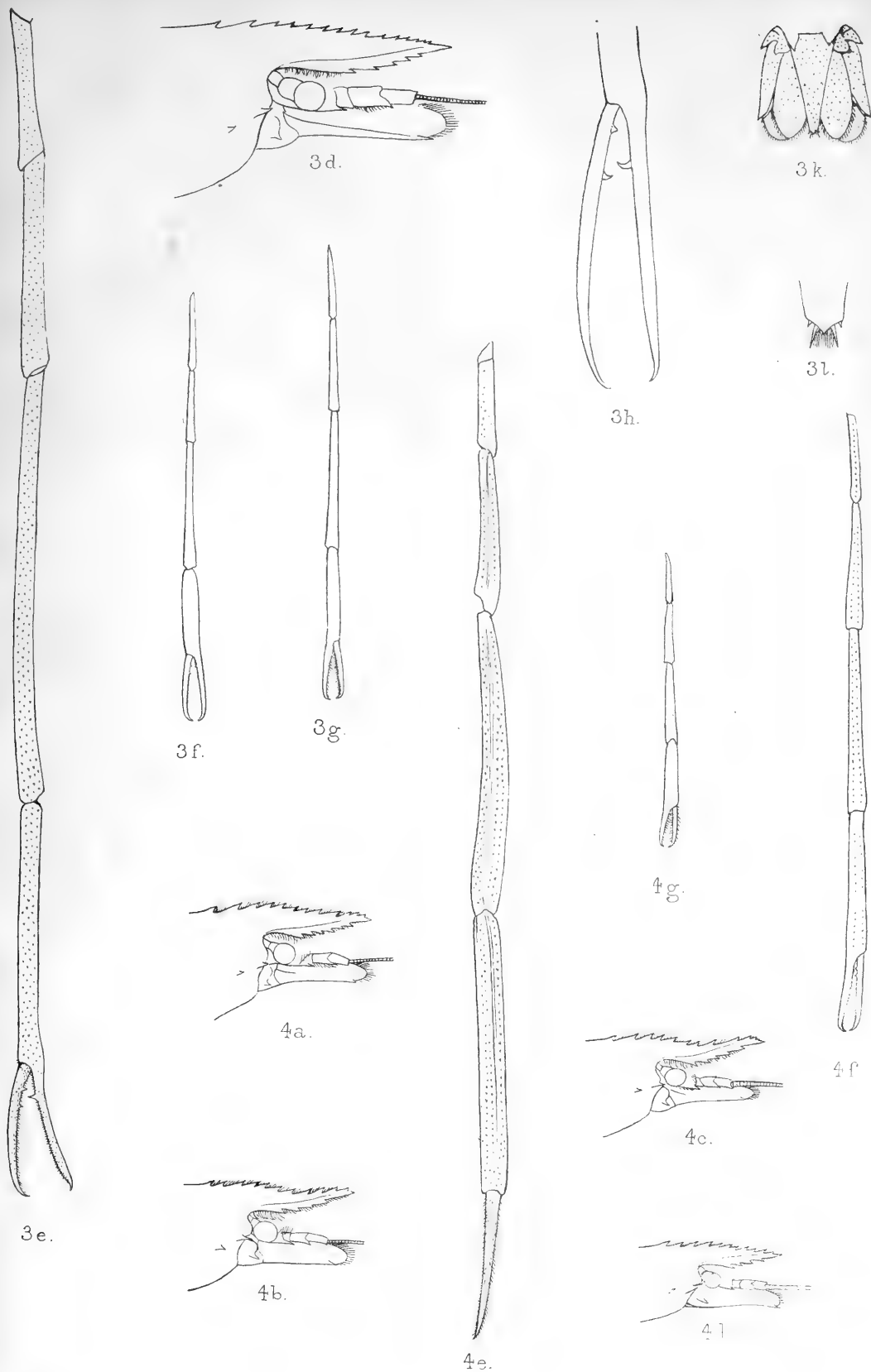
EXPLANATION OF PLATE XVI.

FIG. 3.—*Palaemon idæ*, Heller.

- „ 3*d*.—Cephalic region of ♀ × 2.
- „ 3*e*.—Right chelipede, nat. size (♂ measuring 110 mm.).
- „ 3*f*.—Right chelipede, nat. size (♀ measuring 89 mm.).
- „ 3*g*.—Left chelipede, nat. size (young ♂ measuring 77 mm.).
- „ 3*h*.—Fingers of a Mangalore ♂ to show the teeth × 2.
- „ 3*k*.—Caudal fin, nat. size (♂ measuring 110 mm.).
- „ 3*l*.—Apex of telson × 3 (♂ measuring 110 mm.).

FIG. 4.—*Palaemon sulcatus*, n. sp.

- „ 4*a*.—Cephalic region, nat. size (♂ measuring 93 mm.).
- „ 4*b*.—Cephalic region, nat. size (♂ measuring 82 mm.).
- „ 4*c*.—Cephalic region, nat. size (♂ measuring 82 mm.).
- „ 4*d*.—Cephalic region of ♂, nat. size (measurement lost).
- „ 4*e*.—Right larger chelipede, nat. size (♂ measuring 93 mm.).
- „ 4*f*.—Left short chelipede, nat. size (♂ measuring 93 mm.).
- „ 4*g*.—Left chelipede, nat. size (♀ measuring 71 mm.).



3d-l. *Palaemon idae*, Heller.

4a-g. *Palaemon sulcatus*, n.sp

EXPLANATION OF PLATE XVII.

FIG. 5.—*Palaeomon rudis*, Heller.

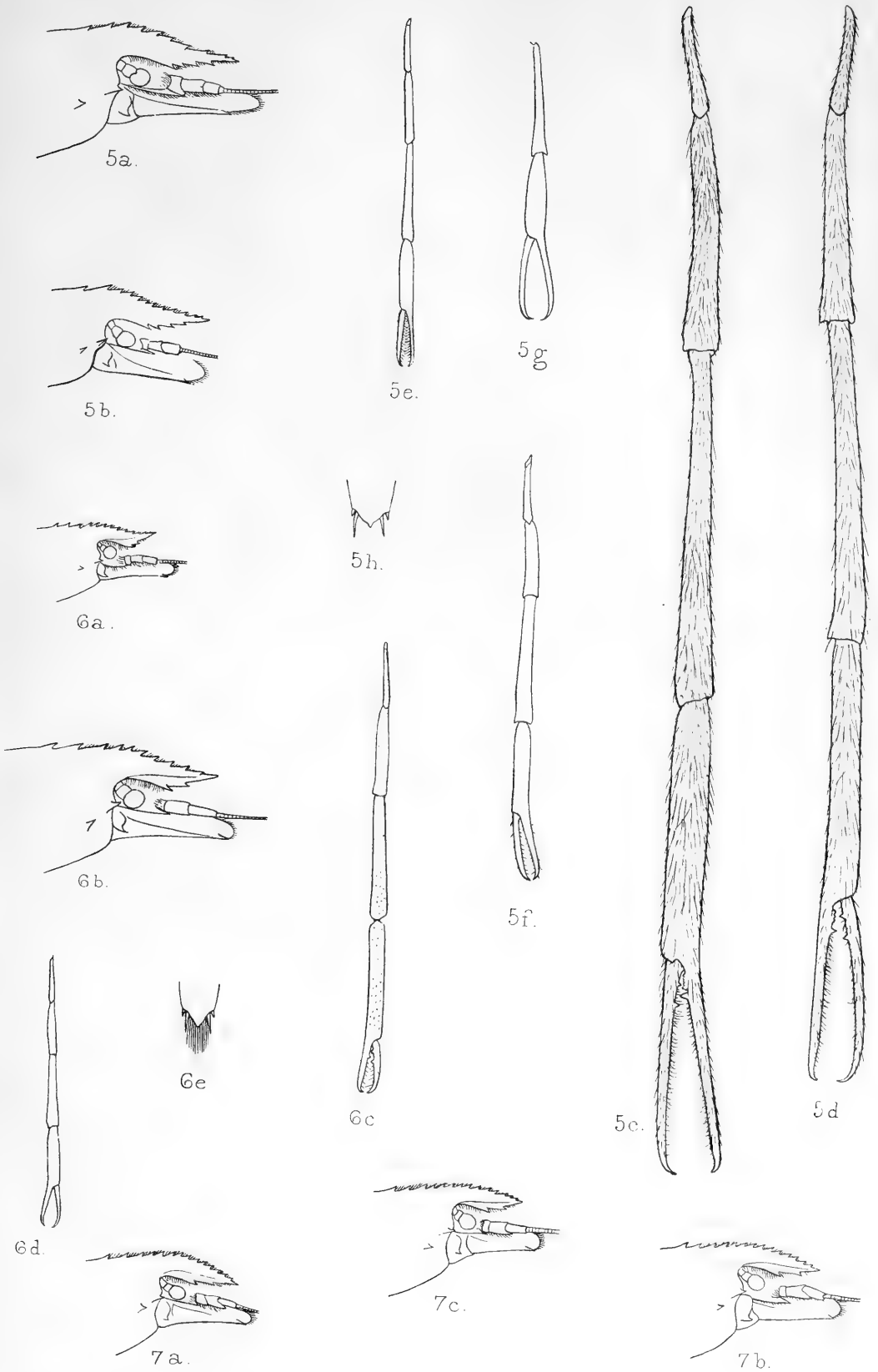
- „ 5a.—Cephalic region, nat. size (♂ measuring 117 mm.).
- „ 5b.—Cephalic region of ♀, nat. size.
- „ 5c.—Right larger chelipede, nat. size (♂ measuring 117 mm.).
- „ 5d.—Left short chelipede, nat. size (♂ measuring 117 mm.).
- „ 5e.—Right chelipede, nat. size (♀ measuring 86 mm.).
- „ 5f.—Regenerated chelipede, nat. size (♂ measuring 105 mm.).
- „ 5g.—Right chelipede showing dilatation of palm, nat. size
(Cocanada ♂ measuring 74 mm.).
- „ 5h.—Apex of telson × 3 (♂ measuring 117 mm.).

FIG. 6.—*Palaemon nobilii*, n. sp.

- „ 6a.—Cephalic region, nat. size (♂ measuring 64 mm.).
- „ 6b.—Cephalic region, × 2 (♀ measuring 54·5 mm.).
- „ 6c.—Left larger chelipede, nat. size (♂ measuring 64 mm.).
- „ 6d.—Left chelipede, nat. size (♀ measuring 54·5 mm.).
- „ 6e.—Apex of telson × 3 (♂ measuring 64 mm.).

FIG. 7.—*Palaemon scabriculus*, Heller.

- „ 7a.—Cephalic region of ♂, nat. size
 - „ 7b.—Cephalic region of ♂, nat. size
 - „ 7c.—Cephalic region of ♂, nat. size
- } showing variation in
shape of rostrum.



5a-h. *Palaemon rudis*, Heller.

6a-e. *Palaemon nobilii*, nsp.

7a-c. *Palaemon scabriculus*, Heller.



EXPLANATION OF PLATE XVIII.

FIG. 7.—*Palaemon scabriculus*, Heller.

- „ 7d.—Left larger chelipede of ♂, nat. size.
- „ 7e.—Right short chelipede of ♂, nat. size.
- „ 7f.—Left larger chelipede of ♂, nat. size.
- „ 7g.—Ischium of ♂, nat. size.
- „ 7h.—Right larger chelipede, nat. size (♀ measuring 46 mm.).
- „ 7k.—Right regenerated chelipede, nat. size (♂ measuring 53 mm.).
- „ 7l.—Apex of telson × 3 (♂ measuring 62 mm.)
- „ 7m.—Apex of telson × 3 (♂ measuring 75 mm.)
- „ 7n.—Apex of telson × 3 (♂ measuring 45 mm.)
- „ 7p.—Apex of telson of ♂ × 3

} showing
variation
in telson
tip.

FIG. 8.—*Palaemon dolichodactylus*, Hilg.

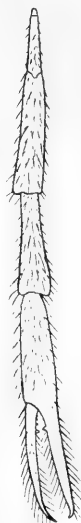
- „ 8a.—Left larger chelipede, nat. size (♂ measuring 75 mm.).
- „ 8b.—Right short chelipede, nat. size (♂ measuring 75 mm.).

FIG. 9.—*Palaemon dubius*, n. sp.

- „ 9a.—Cephalic region, nat. size (♂ measuring 75 mm.).
- „ 9b.—Left larger chelipede, nat. size (♂ measuring 75 mm.).
- „ 9c.—Right short chelipede, nat. size (♂ measuring 75 mm.).
- „ 9d.—Right chelipede, nat. size (♀ measuring 43 mm.).



7d.



7e.



7f.



7g.



7h.



7l.



7k.



7m.



7n.



7p.



8a.



9b.



8b.



9a.



9c.



9d.

7d-p. *Palaemon scabriculus*, Heller.

8a-b. *Palaemon dolichodactylus*, Hilg.

9a-d. *Palaemon dubius*, n.sp.



XXIX. *ALLUAUDELLA HIMALAYENSIS*,
A NEW SPECIES OF DEGENERATE (♂)
COCKROACH.

WITH AN ACCOUNT OF THE VENATION FOUND IN THE GENERA
Cardax AND *Alluaudella*.

By F. H. GRAVELY, *M.Sc.*, Assistant Superintendent, Indian
Museum.

Introductory.

The genus *Cardax* was founded by Mr. Shelford in the year 1908 for the reception of a little *Embia*-like cockroach, male specimens of which were attracted to the lights in Mr. Green's bungalow at Peradeniya in Ceylon. They were forwarded to Mr. Shelford by Dr. Willey, and received the name *Cardax willeyi*. During the present year Mr. Shelford has described a similar male cockroach from the Kulumusi Caves near Tanga, in German East Africa. For this species he has founded a separate genus, the full name of the species being *Alluaudella cavernicola*. From his descriptions the generic distinctions appear to be : the smaller size of the eyes in the latter ; the form of the pronotum, which covers the vertex of the head in the former but not in the latter ; and differences in the venation.

During a recent visit of Dr. Annandale to Kurseong, in the Darjiling district of the Eastern Himalayas (4,700 ft.), a single male specimen of yet another species of *Embia*-like cockroach was found. Like *Cardax willeyi* it was attracted to the light of a house, where it was captured. This specimen has the eyes well-developed as in *Cardax*, but has no ocelli ; the vertex of the head is free of the pronotum, as in *Alluaudella*, whilst the venation is unlike that of either genus.

During a recent visit to Peradeniya I had the good fortune to obtain several specimens of *Cardax willeyi*, all of which were males taken at light in Mr. Green's bungalow. These show considerable variation in their venation, and lead me to suppose that the differences in venation between *Cardax willeyi*, *Alluaudella cavernicola*, and the Kurseong species are of much less importance than appears at first sight. I propose therefore in the present paper to describe this variability in the venation of *Cardax willeyi* ; to emphasize the fundamental uniformity found in the venation of the three species ; to point out the probable relation of this type of venation to that found in other cockroaches ; to

describe the Kurseong specimen under the name *Alluandella himalayensis*; and to redefine the genera *Cardax* and *Alluandella* in accordance with the fresh facts brought forward.

I have to thank Mr. Green for lending me his series of specimens of *Cardax willeyi*, including several of the collection of which the part sent to Shelford formed the basis of the original description of the species.

Variation in the venation of CARDAX WILLEYI, Shelford.

The venation of both the tegmina and wings of *Cardax willeyi* consists of a series of well-defined veins whose origin is practically coincident with the origin of the tegmen (or wing), and which run direct to the margin of that organ, giving off but few branches in their course; and of a series of "secondary" veins having as a rule no defined origin and lying singly between these "primary" veins as they may be termed. The branching of the primary veins is of two kinds. Firstly, branching near the origin, to form in all six long veins which it will be convenient to refer to as primary veins

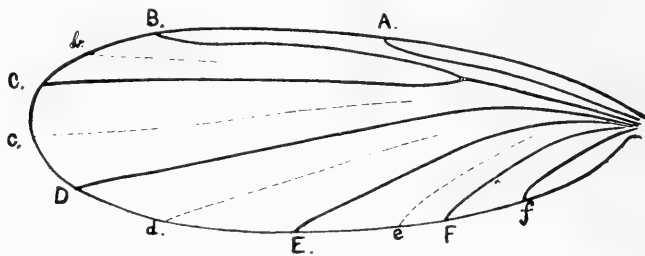


Diagram of the venation of the tegmen of *CARDAX WILLEYI* (♂).

The lettering of the veins corresponds to that used provisionally in the text; the probable relation of these veins to those found in more highly organized cockroach wings is described on p. 310. In the tegmen of *Cardax willeyi* the only difference between the nomenclature here advocated and that adopted by Shelford in his description is that Shelford regards "vein C" as a fork of the radial instead of as a distinct vein corresponding to the *vena spuria*. Primary veins are indicated by heavy lines; secondary ones by dotted lines. Vein *f* is shown by a heavy line, as it is at least as likely to correspond to a true branch of the anal (*i.e.*, to correspond strictly to an axillary vein of other forms) as to be one the series of secondary veins which are here supposed to have possibly arisen *de novo* in the degenerate forms.

A—F respectively¹ (see text fig.); these branches arise in a manner which appears to be constant, and to be the same in all three species of cockroach particularly dealt with in the present paper, differing, however, in the tegmina and wings. And, secondly, branching which occurs nearer the margin of the wing, which is variable—except perhaps in the case of vein E of the wing which in every specimen I have seen is forked, the division occurring further

¹ In order to avoid confusion: the relation of these veins to those of more typical cockroaches will be considered later.

from the margin than in the case of any other vein. Thus vein D of the tegmen (anterior ulnar of Shelford's nomenclature) may be forked near the end (see fig. 1), and Shelford states that the posterior ulnar (vein E) may be similarly forked; and in the wing vein C may (figs. 1, 2 and 3) or may not (fig. 4B) be forked; and in the wing vein C may (figs. 1, 2 and 3) or may not (fig. 4) be forked.

But it is in the secondary veins (*b-f*) that the variations occur which are of special importance in connection with the relation between the types of venation found in these three species. These veins are usually connected with the primary veins between which they lie by a series of more or less ill-defined and very irregular cross-veins. The cross-veins are quite irregular in position, in number, and in intensity; and in some cases the secondary veins may appear to arise as definite branches of some primary vein, and in others very nearly to do so. Thus in the tegmen vein *b* often appears as a branch of vein B (see figs. 2 and 4A) or of vein C (see fig. 2); and in the specimen shown in fig. 3 vein *e* of both tegmina (but one more than the other) tends to appear as a branch of vein E, and vein *c* of the right wing shows a strong tendency to appear simply as a branch of C and *d* of E.

Having thus established the fact that in *Cardax willeyi* the venation consists of a series of constant primary veins (any of which may, however, bifurcate near the margin of the wing), alternating with secondary veins, which show a tendency to fuse with them and so to appear as branches from them, the venation of *Alluaudella carvernicola* and *A. himalayensis* can easily be shown to consist of the same elements somewhat more definitely combined. But before doing this it will be necessary to describe the new species *Alluaudella himalayensis*.

Description of ALLUAUDELLA HIMALAYENSIS, sp. n.

(Figs. 5A and 5B.)

♂ (one specimen only): size, pubescence and antennae as in *Cardax willeyi*; eyes well developed and far apart; ocelli absent; vertex of head not covered by pronotum; pronotum trapezoidal, punctured and pubescent behind and at the sides, with longer hairs more sparsely scattered over a central area extending as a narrow strip to the anterior margin; shape of pronotum, however, not so distinctly transverse as in *Cardax willeyi*. Tegmina and wings resembling those of *Cardax willeyi* in shape, size, texture and pubescence; mediastinal vein very short in tegmina, in the wings rudimentary (in one) or absent (in the other); radial vein rather faint in the tegmina, coincident with a longitudinal crease; no secondary vein developed in front of vein C (= *vena spuria*, see below p. 310) in tegmen or wing; base of vein C received by vein B (= radial) in the tegmen very close to the origin; vein E (= posterior ulnar) in the tegmen receives the base of the succeeding secondary vein (*e*), which is strongly developed and appears simply as a branch of it. Legs long and slender; apical spines of tibia

apparently somewhat fewer than is usual in *Cardax willeyi*; in all other respects the legs resemble those of that species.

*Comparative discussion of the venation found in CARDAX
WILLEYI and in ALLUAUDELLA CAVERNICOLA
and A. HIMALAYENSIS.*

The diagram given above (text-fig., p. 308) of the tegmen of *Cardax willeyi* illustrates the conclusions thus arrived at with regard to the fundamental plan of the venation of that species and will form a useful starting-point in the present discussion.

On comparing this diagram with Shelford's figs. of *Alluaudella cavernicola* and with fig. 5A of the present paper representing *A. himalayensis*, it will be seen that the "triramose posterior ulna" of the tegmen of former is the result of the fusion of veins *d* and *e* with vein *E* (a conclusion which is perhaps further supported by the abrupt junction of the anterior of the apparent branches with the main trunk); whilst the biramose character of this vein in *A. himalayensis* is similarly due to the complete fusion of the proximal end of vein *e* with it. Further, it will be noticed that vein *C* differs from all the other primary veins in having a different point of origin in the tegmina and wings, arising from vein *B* in the former and vein *D* in the latter. Thus it behaves in the two alar organs taken together as the secondary veins behave within the limits of either of these organs in a single species; from which it may be supposed that its ultimate derivation has been from some vein distinct (as the secondary veins now usually are) from the system radiating from the origin of the organ. From this the following homologies for the different primary veins follow quite simply; *A* = mediastinal, *B* = radial, *C* = vena spuria, *D* = anterior ulnar, *E* = posterior ulnar, *F* = anal.

With regard to the origin of the secondary veins there is little definite evidence. It may be pointed out, however, that between the two branches of a forked primary vein traces of a rudimentary vein (see figs. 1 2 and 3, *x*) may sometimes be seen. This vein extends from the margin about half way between the two branches of the primary vein. The secondary veins may perhaps have arisen in this way, and becoming functional as strengthening organs have been fixed by the action of natural selection; though why the usual strengthening veins, arising as branches of the primary veins, should have been replaced in this way it is difficult to see.

It will be noted that in this discussion I have assumed that these simple cockroaches are degenerate rather than primitive. I do this because the highly specialized asymmetrical genitalia (see figs. 2 & 3), and the absence of paired maxillulae, are indications of derivation from a normal Blattid rather than immediately from some more Thysanure-like ancestor; and because the junction of the *vena spuria* sometimes with the radial and sometimes with the anterior ulna indicates that this vein was originally free proximally precisely as it is in other cockroaches. It will be interesting to see, when the

female of one of these forms is discovered, whether it has undergone any simplification parallel to that found in the male; but in view of the restriction of the simplification in the male apparently to the wings, it is perhaps more probable that this is associated with an increase in the specialization of the female for the sedentary life which she must be supposed to lead.

Redescription of genera and species—a summary.

The genera *Cardax* and *Alluaudella* may be at once distinguished from all other known cockroaches by the simplicity of their venation. In both tegmina and wings a *vena spuria* is present which has combined with the mediastinal (which however may be rudimentary) radial, anterior and posterior ulnar, and anal veins to form a definite radial system; and alternating with these veins is a system of secondary veins essentially arising freely in the wing and extending to the margin, but often connected by irregularly developed cross-veins with the primary veins on one or both sides of them, and sometimes so completely joined to one of these veins as to appear simply as a branch of it. So far as is known the posterior ulnar vein of the wing (but not of the tegmen) is invariably forked; and other primary veins are sometimes also forked near the margin of the wing or tegmen in certain specimens. Differences in the venation are therefore apt to be apparently much greater than they really are, and in the three species now known they can hardly be considered of generic importance.

The genera may be distinguished from each other by the absence of ocelli and the exposure of the vertex of the head in *Alluaudella*; and the presence of ocelli and covering of the vertex by the pronotum in *Cardax*.

The latter genus contains one known species only, *C. willeyi*, Shelford; the former contains two species which may be distinguished as follows: eyes reduced (posterior ulnar vein of tegmen joined by the bases of the secondary veins on each side of it), *A. cavernicola*, Shelford; eyes large (posterior ulnar vein of tegmen joined by the base of the secondary vein behind it only, other secondary veins of tegmina and all those of the wings with a distinct tendency likewise to arise from some point in the course of the primary vein immediately in front of them), *A. himalayensis*, sp. n., described above.

List of papers referred to.

1908. Shelford, R.—“Some new Genera and Species of Blattidæ, with notes on the Form of the Pronotum in the subfamily Perisphæriinæ.” *Ann. Mag. Nat. Hist.* (8) i, pp. 157—177, pl. ix-x (1908).
1910. Shelford, R.—“A new cavernicolous Cockroach.” *Ann. Mag. Nat. Hist.* (8) vi, pp. 114—116, text-figs. (1910).
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EXPLANATION OF PLATE XX.

o = ocellus.

x = rudimentary vein.

Fig. 1. *Cardax willeyi*, $\times 8$. Dried specimen; from above.

Fig. 2. *Cardax willeyi*. Specimen mounted in Canada balsam; from above; the head extended forwards by pressure.

A. The whole, $\times 8$.

B. Posterior end of abdomen, $\times 30$.

Fig. 3. *Cardax willeyi*. Specimen mounted in Canada balsam; from below; the head extended forwards by pressure.

A. The whole, $\times 8$.

B. Posterior end of abdomen, $\times 30$.

Fig. 4. *Cardax willeyi*.

A. Left tegmen, $\times 8$.

B. Right wing, $\times 8$.

From a dried specimen.

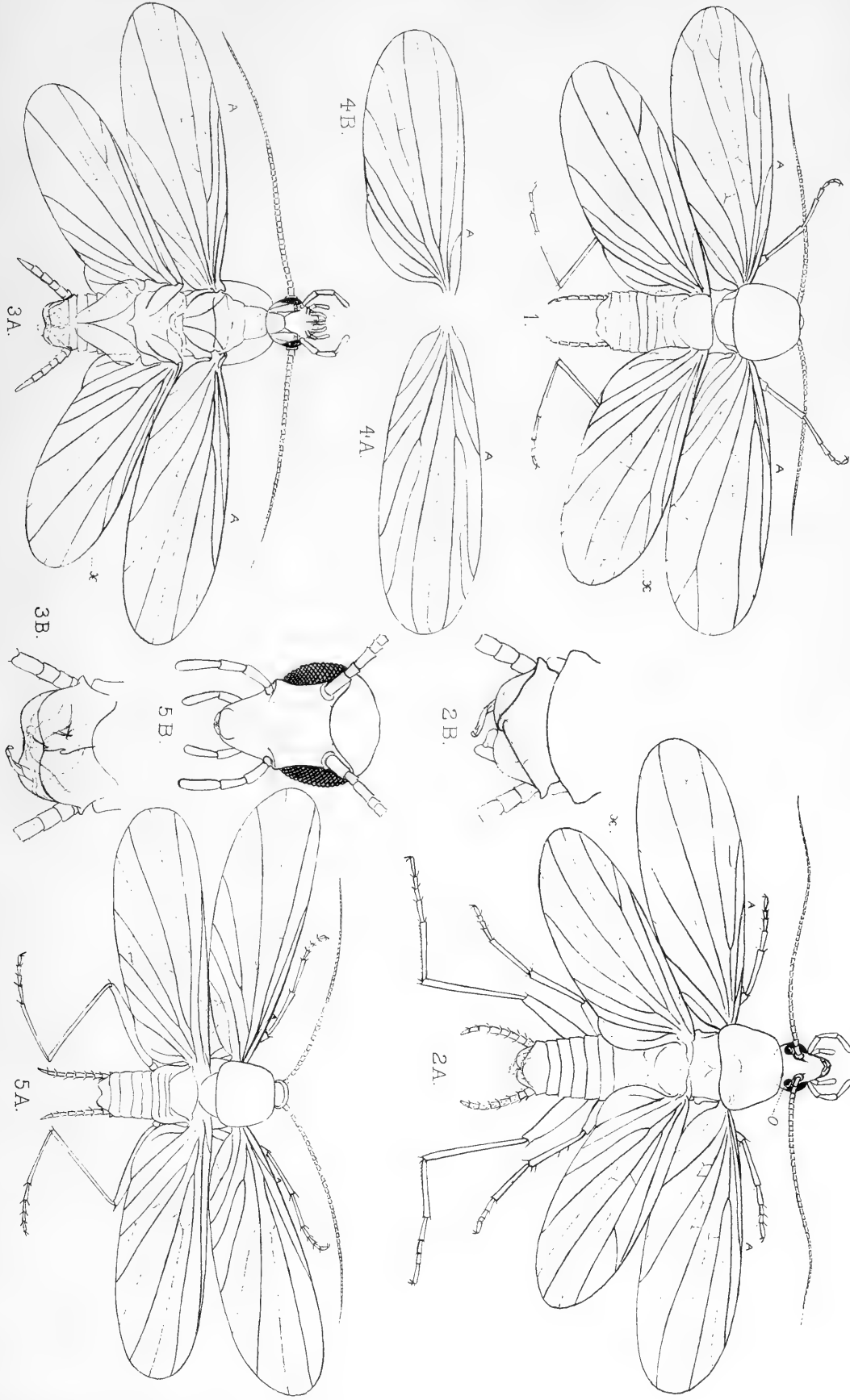
Fig. 5. *Alluaudella himalayensis*.

A. The whole from above, $\times 8$.

B. The head from in front, $\times 35$.

From a dried specimen (the type).

The specimens here figured are all preserved in the collection of the Indian Museum.





XXX. RHYNCHOTA MALAYANA.

PART III.

By W. L. DISTANT.

In this contribution some new species and genera are described and figured from Borneo, but its principal aim is to revise the current enumeration of two sub-families of the Fulgoridæ so far as they are represented in the Malayan Region. In 1901-1902 Dr. Melichar published his "Monographie der Acanaloniiden und Flatiden," a contribution to a knowledge of the Homopterous Rhynchota for which all students were grateful. Unfortunately, however, he worked without any direct knowledge of the numerous species described by Walker in these sub-families, and thus, not unexpectedly fell into dire confusion as to their proper location. I have now dealt with all the Malayan species described and recorded by these two writers, and have sought to correct that part of Melichar's work. The genera and species from extra-Malayan habitats have been discussed in "Ann. and Mag. Nat. Hist." Ser. 8, vol. v, pp 297—322 (1910).

HETEROPTERA.

Fam. PENTATOMIDÆ.

Sub-fam. Phlœinæ.

Genus SERBANA.

Serbana, Dist., Ann. Soc. Ent. Belg., 1906, p. 405.
Type, *S. borneensis*, Dist.

Serbana borneensis. (Pl. xxi, figs. 10, 10a.)

Serbana borneensis, Dist., Ann. Soc. Ent. Belg., 1906, p. 405.

Hab.—Borneo; Kuching, Santubong.

This is at present the only known Malayan representative of the Neotropical family Phlœinæ and is now figured.

Fam. LYGÆIDÆ.

ABGARUS, gen. nov.

Head with the eyes distinctly and strongly stylate projecting distinctly beyond the anterior angles of the pronotum, behind the ocelli narrowed into a very distinct neck which is about half as

long as broad, ocelli between the eyes and much nearer to their insertion than to each other, in front of the ocelli the head is centrally longitudinally grooved; antennæ with the first joint stoutest and passing apex of head, second and third subequal in length, fourth longest; rostrum reaching the intermediate coxæ, first joint reaching the anterior margin of the prosternum; pronotum subquadrate, transversely constricted before middle, before the constriction centrally foveately impressed, behind the constriction very coarsely punctate and somewhat obliquely tumid to base; scutellum longer than broad, punctate; corium a little longer than greatest length of membrane, the costal margin moderately evenly sinuate, the apical angle subacute; membrane with five straight longitudinal veins; legs of moderate length, posterior tarsi with the first joint longer than second and third together.

Allied to *Scopiastes*, Stål, and *Æthalotus*, Stal, but differing principally from both by the produced neck behind the ocelli.

Abgarus typicus, sp. n. (Pl. xxi, figs. 4, 4a.)

Head, anterior area of pronotum and the prosternum pale sanguineous; antennæ, apices of eyes, posterior area of pronotum, scutellum, corium, meso- and metasterna, abdomen, rostrum and legs black or blackish; coxæ, bases of femora and margins to the last three abdominal segments pale stramineous; membrane pale fuliginous, subhyaline, the veins pale fuscous, moderately passing the abdominal apex; basal joints of the tarsi more or less stramineous; structural characters as in generic diagnosis.

Long. 7 mm.

Hab.—Borneo; Kuching (Hewitt).

Genus *ÆTHALOTUS*.

Æthalotus, Stål., En. Hem., iv, p. 98, 1874.

Type, *Æ. afzelii*, Stål.

Æthalotus borneensis, sp. n. (Pl. xxi, figs. 5, 5a.)

Black; bases of the stylate eyes, anterior area of pronotum (excluding central black spot), connexivum, head beneath, prosternum and abdomen beneath sanguineous; legs pitchy-black, coxæ and bases and apices of femora brownish-ochraceous; antennæ with the first joint slightly passing apex of head, second and third sub-equal in length, fourth longest; head centrally longitudinally grooved in front of ocelli; eyes projecting beyond the anterior angles of the pronotum; anterior area of pronotum with a central transverse obliquely curved incised line, near anterior margin a transverse series of punctures in the black spot, posterior area thickly coarsely punctate; membrane very slightly passing the abdominal apex.

Long. $6\frac{1}{2}$ mm.

Hab.—Borneo; Kuching (Hewitt).

Fam. REDUVIIDÆ.**Sub-fam. Holoptilinæ.****Genus PTILO CERUS.**

Ptilocerus, Gray, Zool. Misc., p. 34 (1831).

Type, *P. fuscus*, Gray.

Ptilocerus venosus.

Maotys venosus, Walk. Cat. Het., vii, p. 88 (1873).

Maotys guttifer, Walk. loc. cit., p. 89.

Ptilocerus venosus, Dist., Ann. Mag. Nat. Hist. (7), x, p. 192 (1902).

Ptilocerus ochraceous, Montand., Ann. Mus. Nat. Hung, v, p. 419 (1907).

Hab.—Bangkok, Singapore, Borneo.

Walker separated his two species on the very variable character of the number of marginal cells to the membrane, I have now Dr. Montandon's authority for including his species in the synonymy.

Fam. CAPSIDÆ.**Sub-fam. Isometopinæ.****SKAPANA, gen. nov.**

Head broader than long, rounder in front with the apical margin laminately reflexed, the lateral margins laminately roundly produced in front of and a little before each eye and moderately reflexed; eyes large and prominent situate on each side of base, two distinct ocelli at base between the eyes; antennæ with the first joint very short and thick, hidden beneath the head, second joint long, thickened, finely setose, about as long as pronotum, longer than third and fourth together; rostrum reaching the intermediate coxæ; pronotum about twice as broad as long, the lateral margins rounded and moderately ampliately produced, their edges a little reflexed, the anterior angles obtusely angulately prominent, anterior margin truncate, posterior margin slightly sinuate; mesonotum exposed; scutellum elongate, about as long as breadth at base, convexly tumid, transversely incised near apex; corium broad, the costal area laminately roundly produced; clavus long and slender, reaching the apex of the scutellum; cuneus large a little broader than long; membrane somewhat short but considerably passing the apex of the abdomen, apical margin rounded, an obliquely transverse cell at base; legs short and slender, the posterior femora strongly thickened.

Allied to *Turnebus* Dist.

Skapana typica, sp. nov. (Pl. xxi, figs. 8, 8a.)

Ochraceous; apical margin of head, eyes, central disk of pronotum, exposed mesonotum, clavus, interior area of corium, and narrow lateral and apical margins to cuneus, black or blackish; scutellum castaneous, its extreme apex blackish; membrane fuliginous; antennæ black the third joint pale; rostrum black; body beneath and legs (imperfectly seen in typical specimen) ochraceous, the posterior femora pale castaneous; head finely punctate; pronotum, corium, clavus and cuneus coarsely punctate; scutellum finely punctate; other structural characters as in generic diagnosis.

Long, $5\frac{1}{2}$ mm.

Hab.—Borneo; Kuching (Hewitt).

HOMOPTERA.

Family CICADIDÆ.

Genus PURANA.

Purana, Dist., Ann. Mag. Nat. Hist. (7), xv, p. 60 (1905).

Type, *P. tigrina*, Walk.

Purana conspicua, sp. nov. (Pl. xxi, figs. 7, 7a, 7b.)

Head, pronotum and mesonotum brownish-ochraceous; head with the front anteriorly transversely blackly striate, the striations not meeting centrally and bounded by two black marginal lines, vertex with a large central angulate (narrowing posteriorly) black spot, enclosing the ocelli, with a curved anterior black spot on each side and the inner margin to the eyes black; pronotum with two central longitudinal narrow black fasciæ, united posteriorly, the fissures more or less black and with a transverse spot of the same colour on each lateral margin; mesonotum with five longitudinal black stripes, the central straight and the one on each side of it shortest, a rounded black spot near each anterior angle of the basal cruciform elevation; abdomen above black, greyishly pilose, the lateral margins more or less brownish-ochraceous; body beneath and legs brownish-ochraceous; the transverse striations and apex to face, an oblique stripe on each side between face and eyes, apical halves of cheeks, lateral areas of clypeus, sternal spots and apex of abdomen, black; tegmina hyaline, costal membrane and venation brownish-ochraceous or piceous, the transverse veins at apices of first and second ulnar areas broadly black, and the longitudinal veins to the first three apical areas piceously spotted near their apices, basal cell and base of claval area ochraceous; wings hyaline, the veins brownish ochraceous; head including eyes as wide as base of mesonotum, as long as space between eyes, tympanal coverings in ♂, broader at base than long; face globose, strongly transversely striate; rostrum reaching the poste-

rior coxæ, its apex black; opercula in ♂, short, ochraceous, inwardly more or less margined with piceous, outwardly obliquely rounded, inwardly concave, apices broadly, angularly rounded; tubercles to the second and third ventral segments elongate and slightly curved.

Long. excl. tegm. ♂, 35, ♀, 25 mm. Exp. tegm. ♂, 95, ♀, 90 mm.

Hab.—Borneo; Kuching, Sarawak (Moulton).

A large and conspicuous species.

Genus MOGANNIA.

Mogannia, Amy. and Serv., Hist., Hém., p. 467 (1843).

Type, *M. conica*, Germ.

Mogannia moultoni, sp. nov. (Pl. xxi, figs. 6, 6a, 6b.)

Head chocolate-brown; ocelli red; pronotum olivaceous-green, the anterior and posterior margins narrowly paler green; mesonotum olivaceous-green, with four small obconical spots on anterior margin (the two central spots largest) and a longitudinal fascia on each lateral area, chocolate-brown; abdomen above dark chocolate-brown with a longitudinal fascia on the lateral areas of second, third and fourth segments and a transverse fascia on fifth segment silvery-white; body beneath and legs brownish-ochraceous, the lateral areas of the body silvery-greyishly pilose, intermediate and posterior tibiæ greenish; clypeus black, the cheeks longly, silvery pilose; tegmina and wings hyaline, the veins greenish or piceous, costal membrane to tegmina reddish-brown; head strongly, conically produced in front; posterior margin of pronotum lobately, backwardly produced at each lateral angle; anterior femora spined beneath.

Long. excl. tegm. ♂ and ♀, 13 to 15 mm. Exp. tegm. 40 mm

Hab.—Borneo; Bau and Lawas, Sarawak (Moulton).

Genus LEMURIANA.

Lemuriana, Dist., Ann. Mag. Nat. Hist. (7), xvi, p. 32 (1905).

Type, *L. apicalis*, Germ.

Lemuriana connexa, sp. nov. (Pl. xxi, figs. 12, 12a, 12b.)

Body shining brown, shortly ochraceously pilose; posterior disk of face and clypeus blackish or black; cheeks and sternum very thickly ochraceously pilose; femora and disk of abdomen beneath suffused with darker brown; tegmina hyaline, costal membrane greenish, post-costal area and the venation piceous, transverse veins at the bases of the three upper apical areas infuscated on each side; wings hyaline, the venation and the abdominal area (excluding apex) piceous; face globose, transversely striate and centrally longitudinally sulcate on its upper half;

opercula nearly reaching apex of first abdominal segment, well separated internally, the apices broadly rounded; rostrum almost reaching the posterior coxæ.

Long. excl. tegm. ♀, 16 mm. Exp. tegm. 45 mm.

Hab.—Borneo; Lawas, Sarawak (Moulton).

Fam. FULGORIDÆ.

Sub-fam. Derbinæ.

Genus AFAKIA.

Arfaka, Dist., Ann. Mag. Nat. Hist. (7), xix, p. 397 (1907),
nom. præocc.

Afakia, Kirk. Canad. Ent., xli, p. 391 (1909), *n. nom.*

Kirkaldy proposed the above new name for my genus on erroneous reasons. He wrote "presuming it to be derived from the Papuan village 'Afak' (or as it used to be called 'Offak') Distant has written an intrusive 'r,' which I have omitted in the replacing name."

The Arfak Mts. of New Guinea are usually well known; the "Arfaks" who live there are not unknown to ethnologists, while the word is quite familiar to most naturalists, for few indeed have not read Wallace's "Malay Archipelago." However as the word *Arfaka* has previously been used for a genus of Cicadidæ, Kirkaldy's name is available.

Afakia decisa. (Pl. xxi, figs. 9, 9a.)

Arfaka decisa, Dist., Ann. Mag. Nat. Hist. (7), xix, p. 398 (1907).

Hab.—New Guinea (Wallace, Brit. Mus.).

Sub-fam. Issinæ.

Genus LOLLIIUS.

Lollius, Stål, Hem. Afr., iv, p. 209 (1866).

Type, *L. australicus*, Stål.

Lollius pryeri, sp. nov. (Pl. xxi, figs. 11, 11a.)

Vertex brownish-ochraceous with darker brown spots between the eyes, at apex two foveate spaces the margins of which are ridged, each containing a small tubercle and with a black streak on their posterior margins; pronotum brownish-ochraceous finely spotted with darker brown; abdomen above ochraceous, the lateral and apical areas more or less suffused with fuscous-brown; body beneath and legs ochraceous, the latter more or less annulated with fuscous-brown; face fuscous-brown, mottled with ochraceous, its posterior disk longitudinally foveately impressed, its basal lateral angles slightly but distinctly angularly acute, lateral margins sinuate, broadening to behind eyes, thence oblique to clypeus which is

strongly tumid; posterior tibiae with two strong spines before apex; tegmina ochraceous, spots on costal, apical and claval margins, a large spot on clavus continued across corium as an irregular oblique fascia to near apex, and a subcostal spot near middle, fuscous brown; wings pale fuliginous, the inner and apical areas darker fuliginous.

Long. excl. tegm. 10 mm. Exp. tegm. 25 mm.

Hab.—North Borneo (Pryer—Coll. Dist.).

Sub-fam. Ricaninae.

Genus RICANIA.

Ricania, Germ. Mag. Ent. III, p. 221 (1818).

Type, *R. fenestrata*, Fabr.

Ricania hewitti, sp. n. (Pl. xxi, figs. 1, 1a.)

Head, pronotum and abdomen brownish-ochraceous, mesonotum pale chocolate-brown, body beneath and legs brownish-ochraceous; tegmina pale yellowish, the costal membrane and radial area a little darker and more opaque; costal membrane for about two-thirds its length, apical costal area and the whole of apical margin more or less chocolate-brown with the extreme outer edges spotted with pale yellow, a broken, irregular, transverse macular fascia beyond middle, between which and base are a number of small irregular spots, chocolate-brown; wings hyaline, the apical and posterior margins fuscous-brown; face centrally and sublaterally ridged, none of the ridges reaching the posterior margin; pronotum centrally longitudinally carinate; mesonotum centrally straightly carinate and with a sublateral carinate line on each side which bifurcates from about middle to anterior margin; apical margin of tegmina about as long as inner margin.

Long. excl. tegm. $5\frac{1}{2}$ mm. Exp. tegm. 22 mm.

Hab.—Borneo; Kuching (Hewitt).

Genus MINDURA.

Mindura, Stål, Rio. Jan. Hem., ii, p. 64 (1862).

Type, *M. alligata*, Walk.

Mindura confusa, sp. n. (Pl. xxi, figs. 2, 2a.)

Head, pronotum and abdomen above ochraceous; mesonotum brownish-ochraceous; body beneath and legs ochraceous; tegmina pale ochraceous, about basal half of costal membrane, continued downward as a transverse fascia to near apex of clavus and a subapical spot to costal membrane continued downwards as a subapical transverse marginal fascia, castaneous brown, clavus tinged with brownish; wings subhyaline, the veins and an apical and marginal fascia fuscous-brown; mesonotum finely tricarinate; face

about one and a half times as long as broad, concavely sinuate at inner margins of eyes, two distinct central carinations which neither reach base nor apex and which moderately converge posteriorly, a broader but less sharply defined sublateral carination on each side.

Long. excl. tegm. 7 mm. Exp. tegm. 22 mm.

Hab.—Borneo; Kuching (Hewitt).

Allied to *M. interrupta*, Walk. from Singapore.

Mindura simiana, sp. n. (Pl. xxi, figs. 3, 3a.)

Body above brownish-ochraceous; body beneath and legs a little paler; margins of face and clypeus narrowly castaneous-brown; tegmina shining fuscous-brown, the basal area more or less paler and more ochraceous, two spots on apical half of costal membrane, one at apex, two linear before apical margin, a larger irregular spot before apex of clavus, and a variable cluster of smaller spots nearer base, white; wings subhyaline, the veins, apex and margin fuscous-brown; face shorter and comparatively broader than in the preceding species *M. confusa*, the carinations similar; mesonotum finely tricarinate; lateral margins of vertex acute.

Long. excl. tegm. 8 mm. Exp. tegm. 22 mm.

Hab.—Borneo; Kuching (Hewitt).

Fam. FULGORIDÆ.

Sub-fam. Acanalonünæ.

Genus ORYXANA, gen. nov.

Vertex a little longer than broad, the lateral margins strongly ridged; eyes very large, only a little shorter than vertex, reaching base but not overlapping the pronotum, face posteriorly about as broad as long, obliquely widened from base and suddenly obliquely directed inwardly a little before clypeus, centrally longitudinally carinate, the carination continued through the clypeus and with a short curved carination on each side scarcely reaching middle; pronotum centrally about as long as vertex, the anterior margin angularly produced between eyes, the posterior margin convexly rounded; mesonotum about as long as pronotum, posteriorly angularly produced; tegmina about one-third longer than broad, the costal margin and apical angle broadly convex, apical margin obliquely truncate, the inner angle acute, claval margin nearly straight, costal membrane, wider than radial area, with oblique but furcate veins, remaining area of tegmina more or less reticulately veined; wings considerably shorter than tegmina, two transverse veins on upper apical area.

Type, *O. subacuta*, Walk.

Oryxana subacuta. (Pl. xxii, figs. 6, 6a.)

Flata subacuta, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 179 (1868); Melich. Ann. Hof. Mus. Wien., xvii, p. 230 (1903).

Hab.—Mysol. (Brit. Mus.)

Oryxana lutea.

Nephesa lutea, Walk., Journ. Linn. Soc. Lond. Zool., 1, p. 161 (1857).

Oryxa truncata, Melich. (part), Ann. Hofmus. Wien, xvii, p. 50 (1903).

Hab.—Borneo, Sarawak (Wallace—Brit. Mus.).

Sub-fam. Flatinae.

Genus PHROMNIA.

Phromnia, Stål, Rio. Jan. Hem., 11, p. 68 (1858).

Type, *P. pallida*, Oliv.

Phromnia montivaga.

Phromnia montivaga, Dist., Trans. Ent. Soc. Lond., 1892, p. 284, t. xiii, f. 5, *id.* Faun. B. I. Rhynch., 111, p. 401 (1906).

Flata floccosa, Melich. (part), Ann. Hofmus. Wien, xvi, p. 208 (1901).

Flata rubescens, Melich. (part), *loc. cit.*, p. 209.

Dr. Melichar has made this identification very difficult. Under *P. floccosa*, Guer., he has included my *P. montivaga* of which he correctly gives the reference; but under *P. rubescens* he has included my *P. parmata* to which he has again referred the figure of *P. montivaga*. The same figure he has thus made to represent what he proposes as synonyms of two distinct species.

Hab.—Borneo, Siamese Malay States (Annandale and Robinson).

Phromnia flaccida.

Flata flaccida, Walk., Ins. Saund. Hom., p. 50 (1858).

Phromnia hamifera, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 181 (1870).

Flata hamifera, Melich. Ann. Hofmus. Wien, xvi, p. 211, (1901).

Flata floccosa, Melich. (part), *loc. cit.*, p. 208.

Hab.—Sumatra, Java, Borneo.

Genus FLATOSOMA.

Flatosoma, Melich., Ann. Hofmus. Wien., xvi, p. 244 (1901).

Type, *F. signoreti*, Melich.

Flatosoma melichari, sp. n.

Flatosoma comma, Melich. (nec Walk.), Ann. Hofmus. Wien, xvi, p. 244 (1901), T. vii, f. 14 (1902).

Hab.—Borneo.

This is the species described and figured by Melichar as *F. comma*, Walk., a species which forms the type of my genus *Chaturbujia*. In fresh specimens the colour of the tegmina is virescent, in faded examples it is ochraceous.

Genus ORYXA.

Oryxa, Melich., Ann. Hofmus. Wien, xvii, p. 50 (1903).

Type, *O. truncata*, Linn.

Oryxa truncata.

Fulgora truncata, Linn. Syst. Nat., ii, ed. xii, p. 704, 8 (1767).

Oryxa truncata, Melich. (part), Ann. Hofmus. Wien, xvii, p. 50 (1903).

Oryxa truncata, Dist., Faun. B. I. Rhynch., iii, p. 439, fig. 233 (1906).

Pæciloptera addita, Walk., List. Hom., ii, p. 448 (1851).

Pæciloptera plana, Walk., loc. cit., p. 463.

Colobesthes falcata, Melich. (part), Ann. Hofmus. Wien, xvii, p. 43 (1903).

Hab.—Java, Borneo, India.

Genus MELICHARIA.

Melicharia, Kirk., Entomologist, xxxiii, p. 294 (1900).

Type, *M. quadrata*, Kirby.

Melicharia tripars.

Nephesa tripars, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 161 (1857).

Hab.—Borneo.

Allied to *M. quadrata*, Kirby.

Melicharia luteimargo.

Pæciloptera luteimargo, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 92 (1857); Melich., Ann. Hofmus. Wien, xvii, p. 230 (1903).

Hab.—Singapore.

Melicharia niveina.

Pæciloptera niveina, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 92 (1857); Melich., Ann. Hofmus. Wien, xvii, p. 230 (1903).

Nephesa deducta, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 161 (1857).

Ormenis deducta, Melich., Ann. Hofmus. Wien, xvii, p. 85 (1903).

Hab.—Malacca, Borneo.

Ormenis ? *baramia*, sp. n. (Pl. xxii, figs. 12, 12a.)

Head, pronotum and mesonotum virescent, abdomen above and body beneath and legs pale ochraceous, the dorsal surface of the abdomen thickly whitey tomentose; tegmina pale greenish, the costal, apical and inner margin as far as claval apex, rather broadly ochraceous, at apex of clavus a comparatively large piceous spot; wings creamy-white with a slightly greenish tint; face with the

central longitudinal carination not extending beyond middle; vertex a little more than twice broader than long, centrally and longitudinally carinate; tegmina about twice as long as broad, costal margin a little arched, apical margin subtruncate, the apical and posterior angles rounded, inner margin slightly angularly sinuate at apex of clavus, two transverse lines formed of transverse veins on apical area, the outermost enclosing a rather larger space than that between the outermost and innermost, claval area strongly granulose and a few smaller granules on basal disk.

Long. excl. tegm. ♀, 5 mm. Exp. tegm. 14 mm.

Hab.—N. W. Borneo; Baram (Brit. Mus.).

The genus *Ormenis* was by Melichar made to include the genus *Melicharia*, a course to which I dissent. The above species, however, has apparently all the characters of *Ormenis* (which I regard as of Neotropical and Nearctic distribution), and in fact has a strong resemblance to *Ormenis obtusa* from Bogota, described and figured by Dr. Melichar.

LOMBOKIA, gen. nov.

Vertex about as long as pronotum, obliquely deflected on each side, subconically narrowed to apex, strongly, longitudinally, centrally sulcate, eyes projecting over anterior margins of pronotum; face longer than broad, centrally longitudinally carinate, base obliquely narrowed, lateral margins laminately reflexed, posteriorly obliquely narrowed to clypeus which is centrally carinate; pronotum centrally longitudinally carinate, obliquely deflected on each side, posterior margin angularly concave; mesonotum mutilated in typical specimen; legs somewhat short, posterior tibiae with a single spine beyond middle; tegmina less than twice as long as broad, about basal half of costal margin strongly arched and then somewhat sinuately, obliquely directed to apex, apical margin obliquely truncate, posterior margin angularly sinuate at claval apex, costal membrane narrower than radial area, two longitudinal veins from basal cell, the uppermost with about five oblique veinlets, the whole surface more or less distinctly transversely veined, the claval area strongly granulose; wings a little narrower than tegmina, two transverse veins before apex.

Lombokia everetti, sp. n. (Pl. xxii, figs. 16, 16a.)

Body and legs greenish-ochraceous, anterior and intermediate tibiae slightly tinged with sanguineous; tegmina virescent with numerous dull reddish spots of which the largest is discal and a little beyond middle, the spots smaller and more numerous in and beyond costal membrane, the margins from base to claval apex finely spotted with dull reddish, the granules in claval area piceous; wings milky-white.

Long. excl. tegm. 5 mm. Exp. tegm. 17 mm.

Hab.—Lombok (Everett—Brit. Mus.).

Genus EUPHANTA.

Euphanta, Melich., Ann. Hofmus. Wien, xvii, p. 38 (1903).

Type, *E. munda*, Walk.

Melichar has enumerated three species under this genus, but has not indicated the type. One of the three *P. munda*, Walk., I have selected as type, for it is the only one known to me at present, and I have to take it as representing the genus.

Euphanta pokiana, sp. n.

Head, pronotum and mesonotum pale green, the central continuous carination to each dull reddish, on mesonotum often ochraceous; abdomen above and body beneath dull ochraceous, legs paler with the apices of tibiæ and the tarsi ochraceous; tegmina pale virescent, the costal margin from apex of costal membrane and apical margin continued to claval apex very narrowly and often obsoletely sanguineous; wings milky-white; vertex about as long as pronotum, centrally longitudinally strongly carinate; face with the sublateral carinations becoming obsolete before reaching base of clypeus; pronotum centrally strongly longitudinally carinate; mesonotum tricarinate, the central carination much the strongest; tegmina twice as long as broad, moderately arched at base, apical margin slightly roundly truncate, posterior margin angularly sinuate at apex of clavus which is sub-prominently granulose.

Long. excl. tegm. ♂ and ♀, 7 to 8½ m. Exp. tegm. 19 to 22 m.

Hab.—Brit. New Guinea; Pokia Mailu (Brit. Mus.).

Euphanta chlorospila. (Pl. xxii, figs. 10, 10a.)

Nephesa chlorospila, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 173 (1868).

Cromna chlorospila, Melich. (part), Ann. Hofmus. Wien, xvii, p. 61 (1903).

Hab.—Mysol; New Guinea (Brit. Mus.).

Euphanta quadripunctata.

Cromna quadripunctata, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 182 (1868).

Cromna chlorospila, Melich. (part), Ann. Hofmus. Wien, xvii, p. 61 (1903).

Hab.—Mysol (Brit. Mus.).

Euphanta monoleuca.

Nephesa monoleuca, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 177 (1868).

Cromna chlorospila, Melich. (part), Ann. Hofmus. Wien, xvii, p. 61 (1903).

Hab.—New Guinea (Brit. Mus.).

COLGAROIDES, gen. nov.

Allied to *Colgar*, Kirk., but differing by the structure of the face, which is much the same shape as in *Colgar* but possesses five

carinations, *viz.*, one central straight and longitudinal, one on each lateral area commencing on lateral margin about midway between base and eyes and curved inwardly before clypeus, and a short longitudinal one commencing on each side of base and not reaching middle, the lateral margins from eyes laminately reflexed; clypeus less convex than in *Colgar* and obliquely reflexed on each side, centrally longitudinally strongly carinate.

Type, *C. acuminata*, Walk.

Colgaroides acuminata.

Pæciloptera acuminata, Walk., List. Hom., ii, p. 460 (1851).

Cromna frontalis, Melich., Ann. Hofmus. Wien, xvii, p. 59 (1902).

Cromna surrecta, Melich. (part), *loc. cit.*

Hab.—“New Holland” (Brit. Mus.); New Guinea; Port Moresby (Brit. Mus.).

Colgaroides everetti, sp. n. (Pl. xxii, figs. 8, 8a.)

Body, legs and tegmina bright ochraceous; abdomen above and body beneath more or less greyishly tomentose; eyes black; tegmina with the costal margin from tip of costal membrane and the apical margin continued to apex of clavus, sanguineous; wings milky-white; vertex a little longer than pronotum, centrally longitudinally carinate, apically moderately recurved; face with five carinations, arranged as in *C. acuminata*, Walk.; pronotum with a strong central longitudinal carination; mesonotum strongly tricarinate, the central one much the strongest, the sub-lateral carinations converging posteriorly; tegmina twice as long as broad, costal margin slightly arched at base, apical margin obliquely truncate, posterior margin somewhat strongly sinuate; clavus sub-prominently granulose.

Long. excl. tegm. ♂ and ♀, 8 to 10 mm. Exp. tegm. 19 to 23 mm.

Hab.—Philippines; Savu (Everett—Brit. Mus.).

Genus LAWANA.

Phyma, Melich., Ann. Hofmus. Wien, xvii, p. 43 (1903); *nom. præocc.*

Lawana, Dist., Faun. B. I. Rhynch., III, p. 420 (1906); *nom. nov.*

Type, *L. candida*, Fabr.

Lawana exaltata.

Colobesthes exaltata, Walk., Journ. Ent., I, p. 312 (1862).

Hab.—Timor.

Lawana optata.

Phyma optata, Melich. (excl. syn.), Ann. Hofmus. Wien, xvii, p. 49, t. iv, f. 12 (1903).

Hab.—Penang, Singapore, Sumatra, Java.

Lawana modesta, sp. n. (Pl. xxii, figs. 1, 1a.)

Body and legs dull ochraceous, abdomen and sternum distinctly paler; tegmina pale subhyaline, talc-like, the venation, costal membrane and claval area pale ochraceous, an oblique discal series of four somewhat indistinct milky-white spots beyond middle, the lower spot the largest; wings milky-white; vertex broadly subconical, moderately upwardly and forwardly produced, non-carinate; mesonotum tricarinate; tegmina about twice as long as broad, apically ampliate, costal margin moderately rounded near base, apical margin truncate, posterior angles subacutely produced.

Long. excl. tegm. 11 mm. Exp. tegm. 35 mm.

Hab.—Malay Peninsula; Pahang (Atkinson Coll.—Brit. Mus.).

This species is apparently allied to the *L. (Phyma) hyalina*, Schmidt, from North Borneo, but does not agree with the characters given for that species—“Deckflügel mit drei undeutlichen Subapicallinien und ohne Punkt im corium.”

PHYMOIDES, gen. nov.

Vertex about as long as pronotum, broadly subconical, moderately upwardly and forwardly produced, strongly centrally longitudinally carinate, the posterior lateral margins oblique and spinous on each side, face much longer than broad, centrally longitudinally strongly ridged, the lateral margins strongly acutely ampliate, narrowing to clypeus and only extending a little above eyes, thence the margins are ridged, non-ampliate, and narrowing to base; pronotum tricarinate, anterior margin truncate, the basal margin concave; mesonotum finely tricarinate; tegmina about half as long again as broad, apically ampliate, costal margin somewhat roundly arched, apical margin subtruncate, the posterior angles subacutely produced, costal membrane and radial area subequal in width, beyond the costal membrane the veins are broadly bifurcate and ridged at margin, all the veins bifurcate, in some cases trifurcate on apical margin, basal area and clavus strongly granulose; wings subequal in breadth to tegmina, a few transverse veins before apical area; the venation of tegmina and wings fully shown in figure of type.

Allied to *Lawana* but differing in the shape and structure of vertex, and face and in the venation of the tegmina.

Type, *P. rubromaculatus*, Dist.

Phymoides rubromaculatus, sp. n. (Pl. xxii, figs. 2, 2a.)

Body and legs pale ochraceous; tegmina opaque creamy-white with a longitudinal central series of three sanguineous spots situate regularly but somewhat widely apart; wings creamy-white; other structural characters as in generic diagnosis.

Long. excl. tegm. 10 mm. Exp. tegm. 30 mm.

Hab.—Aru Islands (Wallace—Brit. Mus.).

Phymoides atromaculatus, sp. n.

Body and legs dull ochraceous; tegmina creamy-white with a slightly ochraceous tint on basal area and clavus, two central slightly elongate black spots one near base and the other at about middle; wings creamy-white.

A smaller species than *P. rubromaculatus* with the face a little broader and its lateral margins distinctly angularly sinuate before middle; tegmina marked with two black spots, and not with three red spots as in preceding species.

Long. excl. tegm. $7\frac{1}{2}$ mm. Exp. tegm. 25 mm.

Hab.—Dorey (Wallace—Brit. Mus.).

Genus DAKSHA.

Daksha, Dist., Faun. B. I. Rhynch., iii, p. 425 (1906).

Type, *D. marginata*, Walk.

Daksha pryeri.

Flata (Colobesthes) pryeri, Dist., Trans. Ent. Soc. Lond., p. 153 (1880).

Phyma divisa, Melich., Ann. Hofmus. Wien, xvii, p. 48 (1903).

Hab.—Borneo.

PARADAKSHA, gen. nov.

Head excluding eyes a little broader than anterior margin of pronotum, slightly convex, truncate in front, wider at apex than at base, centrally and laterally carinate, the angles at the base spinous and produced behind the eyes and along the anterior lateral margins of the pronotum; face longer than broad, centrally longitudinally carinate, the lateral margins laminately reflexed and for about one-third from base where the margin is roundly oblique, narrowing at base; pronotum about as long as vertex, the anterior and posterior margins truncate, the lateral margins strongly oblique; mesonotum tricarinate; tegmina about half as long again as broad, convexly arched at base, the apical margin roundly truncate, the posterior angles moderately subacutely produced, the venation generally as in *Phymoides* from which genus it differs by the anteriorly truncate head, different facial structure, and the rounded apical margin to the tegmina.

Type, *P. meeki*, Dist.

Paradaksha meeki, sp. n. (Pl. xxii, figs. 3, 3a.)

Body and legs dull ochraceous; tarsi apically black; tegmina greyish-white, the margins narrowly, somewhat faintly fuscous; two discal black spots, one near base, the other near middle, the base and claval area moderately ochraceous; wings milky-white; structural characters as in generic diagnosis.

Long. excl. tegm. 9 mm. Exp. tegm. 30 mm.

Hab.—Queensland; Cedar Bay, S. of Cooktown (Meek—Brit. Mus.).

NEODAKSHA, gen. nov.

Vertex subquadrate, truncate anteriorly, strongly centrally longitudinally carinate, the lateral margins ampiately and upwardly carinate, their anterior angles acute; face longer than broad, centrally longitudinally carinate, the base angulate, the lateral margins ampiately reflexed, their anterior angles acute, and narrowing towards clypeus which is subequal in length to face; pronotum a little longer than vertex, tricarinate, anterior margin subtruncate, not wider than vertex, posterior margin slightly concave; mesonotum tricarinate (somewhat mutilated in type); legs moderate in length, sulcate, posterior tibiæ moderately curved; tegmina about half as long again as broad, costal membrane a little broader than radial area, transversely veined, the series more or less continued on apical margin, the whole surface with more or less distinct transverse veins; wings about as broad as tegmina, three transverse veins before apical area.

Type, *N. quadriguttata*, Walk.

Neodaksha quadriguttata. (Pl. xxii, figs. 9, 9a.)

Flata quadriguttata, Walk., Journ. Linn. Soc. Lond., x, p. 179 (1868).

Colgar quadriguttata Melich., Ann. Hofmus. Wien, xvii, p. 115 (1903).

Hab.—New Guinea.

The anterior and intermediate tibiæ and tarsi are black.

CIRCUMDAKSHA, gen. nov.

Vertex broader than long, tricarinate, the anterior margin transversely undulate, the lateral margins laminately reflexed, a little narrowed posteriorly; face about as long as broad at base, the lateral margins reflexed and narrowed to clypeus which is very long, about half as long again as face; pronotum not distinctly carinate, anterior margin rounded between the eyes, lateral margins sinuate, posterior margin concave; mesonotum tricarinate, twice as long as pronotum; legs moderate in length, tibiæ sulcate, posterior tibiæ with two spines before apex; tegmina about one and a half times as long as broad, apical margin convex, costal membrane slightly narrower than radial area, the whole surface with numerous indistinct transverse veins, except on apical marginal area; clavus somewhat coarsely granulose; wings about as broad as tegmina, two transverse veins before apex.

Circumdaksha rufosparsa, sp. n. (Pl. xxii, figs. 7, 7a.)

Vertex, pronotum and scutellum greyish-ochraceous; abdomen above whitely tomentose; body beneath and legs very pale ochraceous, the abdomen beneath more or less whitely tomentose,

tarsi black, the clavus castaneous; tegmina white, talc-like, with six or eight red spots arranged in two series, the first in radial area, the second near middle (these spots are inconstant in number, even in the same specimen, as can be seen in the right and left tegmen of the specimen figured); wings milky-white.

Long. excl. tegm. 12 mm. Exp. tegm. 40 mm.

Hab.—Celebes; Macasser (Doherty—Brit. Mus.).

Genus PHYLLYPHANTA.

Phyllyphanta, Amy. and Serv. Hist. Hém., p. 522 (1843).

Type, *P. producta*, Spin.

Phyllyphanta producta.

Pæcilopectera producta, Spin. Ann. Soc. Ent. Fr., viii, p. 432 (1839).

Pæcilopectera bipunctata, Walk., Journ. Ent., 1, p. 312 (1862).

Phyllyphanta sinensis, Melich. (part), Ann. Hofmus. Wien, xvii, p. 56 (1903).

Hab.—Malay Archipelago. Siam.

Phyllyphanta albidosparsa, sp. n. (Pl. xxii, figs. 5, 5a.)

Vertex, pronotum and scutellum brownish-ochraceous, the lateral areas longitudinally olivaceous green; abdomen above brownish ochraceous, more or less greyishly tomentose; face dull greenish, body and legs more or less greenish-ochraceous, tarsi brownish-ochraceous; tegmina dull greenish, the margins very narrowly ochraceous, the veins darker, ornamented with small greenish-white spots, the most prominent of which are a double series in radial area, a broken subapical marginal series, a lunate piceous line on disk beyond middle; two clusters on middle disk, and a short curved series above clavus; wings milky-white; vertex about as long as pronotum, angularly produced anteriorly, strongly centrally longitudinally ridged, the sides obliquely declivous; face much longer than broad, smooth, its base angularly narrowed, its lateral margins slightly ridged; tegmina about as broad as wings, apically ampliate, apical margin truncate, its posterior angle acutely produced.

Long. excl. tegm. 13 to 14 mm. Exp. tegm. 38 to 40 mm.

Hab.—Borneo; Brunnei (Brit. Mus.).

NEOCROMNA, gen. nov.

Head subconically produced in front of eyes, its lateral and posterior margins distinctly ridged and with a somewhat obscure central longitudinal carinate line; face narrowed and conical at base for about one-third its length, after which the lateral margins are strongly ampliatly reflexed and obliquely narrowing to clypeus, strongly centrally longitudinally carinate; pronotum a little shorter than vertex, faintly centrally longitudinally ridged, its

posterior margin concave; mesonotum tricarinate; tegmina as broad or slightly broader than wings, twice as broad at apex as at base, the posterior angle subacutely produced, the costal margin arched and convex, the apical margin more or less truncate; costal membrane about as broad as radial area, the former somewhat thickly transversely veined, the latter somewhat reticulately veined, all the tegmen transversely veined, some of the veins reticulate, except on apical margin where the veins are shortly longitudinal defining a marginal series of short cellular areas; clavus transversely veined above the claval vein, beneath it coarsely granulate; wings with one or two transverse veins near apex, many of the longitudinal veins furcate.

Type, *N. bistriguttata*, Stål.

Allied to *Phyllyphanta* from which it differs by the structure of the face which is obliquely narrowed to clypeus and is strongly centrally carinate.

Neocromna bistriguttata. (Pl. xxii, figs. 4, 4a.)

Nephesa bistriguttata, Stål, Trans. Ent. Soc. Lond. (3), 1, p. 591 (1863).

Colgar bistriguttata, Melich., Ann. Hofmus. Wien, xvii, p. 115 (1903), excl. fig.

Hab.—Papua. (Type in Brit. Mus.).

Genus NEOMELICHARIA.

Atella, Stål (part), Hem. Afr., iv, p. 238 (1866); *id.* Berl. Ent. Zeitschr., x, p. 394 (1866), *nom. præocc.*

Neomelicharia, Kirk., Entomologist, xxxvi, p. 79 (1903).

Colgar, Melich. (part), Ann. Hofmus. Wien, xvii, p. 107 (1903).

Type, *N. cruentata*, Fabr.

Neomelicharia erubescens.

Pæcilopectera erubescens, Walk., Journ. Ent., 1, p. 313 (1862).

Nephesa gemmifera, Stål, Trans. Ent. Soc. Lond. (3), 1, p. 592 (1863).

Atella gemmifera, Stål, Berl. Ent. Zeitschr., x, p. 394 (1866).

Colgar gemmifera, Melich., Ann. Hofmus. Wien, xvii, p. 111 (1903).

Hab.—Batchian.

Both Walker's and Stål's types are in the British Museum.

Neomelicharia consociata.

Pæcilopectera consociata, Walk., Journ. Ent., 1, p. 314 (1862).

Nephesa cicatricosa, Stål, Trans. Ent. Soc. Lond. (3), 1, p. 592 (1863).

Atella cicatricosa, Stål, Berl. Ent. Zeitschr., x, p. 394 (1866).

Nephesa consociata, Walk., Journ. Linn. Soc. Lond., x, p. 171 (1868).

Colgar cicatricosa, Melich., Ann. Hofmus. Wien, xvii, p. 112 (1903).

Hab.—Batchian, Ternate.

The types of both Walker and Stål are in the British Museum.

Neomelicharia conficita.

Nephesa conficita, Walk., Journ. Linn. Soc. Lond., x, p. 172 (1868).

Colgar conficita, Melich., Ann. Hofmus. Wien, xvii, p. 109 (1903).

Hab.—Batchian, Gilolo.

Neomelicharia pustulata.

Cicada pustulata, Don Ins. New Holl., t. 9 (1805).

Colgar pustulata, Melich. (part), Ann. Hofmus. Wien, xvii, p. 109 (1903).

Hab.—Amboina.

Neomelicharia cruentata.

Flata cruentata, Fabr., Syst. Rhyng., iv, p. 46 (1803).

Atella cruentata, Stål, Hem. Fabr., ii, p. 108 (1869).

Nephesa roseigutta, Walk., Ins. Saund. Hom., p. 49 (1858).

Nephesa amæna, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 172 (1868).

Colgar pustulata, Melich. (part), Ann. Hofmus. Wien, xvii, p. 109 (1903).

Colgar cruentata, Melich., loc. cit., p. 110.

Hab.—Papua.

Neomelicharia ocellifera.

Pæcilopectera ocellifera, Walk., List. Hom. Suppl., p. 112 (1858).

Cromna centralis, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 182 (1868).

Colgar ocellifera, Melich., Ann. Hofmus. Wien, xvii, p. 113 (1903).

Colgar diversa, Melich., loc. cit., t. iv, fig. 1.

Hab.—Papua.

Neomelicharia marginalis.

Nephesa marginalis, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 175 (1858).

? *Colgar semilata*, Melich., Ann. Hofmus. Wien, xvii, p. 116 (1903).

Hab.—Papua.

Neomelicharia calochroma.

Pæcilopectera calochroma, Walk., List. Hom. Suppl., p. 113 (1858).

Nephesa calochroma, Stål, Öfv. Vet.-Ak. Förh., xxvii, p. 773 (1870).

Colgar calochroma Melich., Ann. Hofmus. Wien, xvii, p. 109 (1903).

Hab.—Philippines.

Genus NEPHEsa.

Nephesa, Amy. and Serv. Hist., Hém., p. 527 (1843).

Type, *N. rosea*, Spin.

Nephesa rosea.

Ricania rosea, Spin., Ann. Soc. Ent. Fr. (1), viii, p. 400 (1839);

Stål, Berl. Ent. Zeit., 1866, p. 393.

Pæcilopectera completa, Walk., List. Hom., ii, p. 451 (1851).

Pæcilopectera extricata, Walk., Ins. Saund. Hom., p. 52 (1858).

Hab.—Java, Sumatra, Borneo.

Stål (*supra*) stated that the *P. completa*, Walk. = *rosea*, Spin. The *P. extricata*, Walk., is an exact synonym of *P. completa*, Walk., or is apparently the ♀ form of the species.

Nephesa rectilinea.

Colobesthes rectilinea, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 180 (1868).

Nephesa truncaticornis, Melich. (part), Ann. Hofmus. Wien, xvii, p. 103 (1903).

Hab.—Sumatra, Borneo.

Nephesa rectimargo.

Pæcilopectera rectimargo, Walk., Ins. Saund. Hom., p. 51 (1858).

Nephesa truncaticornis, Melich. (part), Ann. Hofmus. Wien, xvii, p. 103 (1903).

Nephesa longipennis, Melich., Ann. Hofmus. Wien, xvii, p. 103 (1903).

Hab.—Penang, Malacca.

Melichar has placed this species (firstly) as a synonym of *N. truncaticornis*, Spin., and (secondly) redescribed it (*P. rectimargo*, Walk., ♀) as a n. sp. *N. longipennis*, Melich.

The type and only representative in the Brit. Mus. is a female specimen.

Nephesa rorida.

Pæcilopectera rorida, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 161 (1867); Melich., Ann. Hofmus. Wien, xvii, p. 106 (1903).

Nephesa intrusa, Melich., Ann. Hofmus. Wien, xvii, p. 103, t. iii, f. 7 (1903).

Hab.—Borneo, Sumatra.

Nephesa suffusa.

Pæcilopectera suffusa, Walk., List. Hom., ii, p. 446 (1851).

Nephesa brunnea, Melich., Ann. Hofmus. Wien, xvii, p. 104 (1903).

Hab.—Java.

Nephesa grata.

Nephesa grata, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 160, (1857).

Cromna peracuta, Melich. (part), Ann. Hofmus. Wien, xvii, p. 62 (1903).

Hab.—Borneo.

Nephesa sandakanensis, sp. n. (Pl. xxii, figs. 11, 11a.)

Head and pronotum pale brownish; pronotum with two longitudinal spots on anterior area and two longer spots on disk, fuscous-brown; abdomen above greyishly tomentose; body beneath and legs greyish brown, the body more or less greyishly tomentose; tegmina tawny brown with numerous small white spots, the inner area above clavus a discal sublunate spot beyond middle, above which is an obscure transverse costal spot, pale ochraceous brown, extreme inner margin distinctly darker; wings milky-white; vertex transverse, with three longitudinal ridges; eyes piceous; tegmina about twice as long as broad; clavus distinctly but moderately granulose.

Long. excl. tegm. 11 mm. Exp. tegm. 38 mm.

Hab.—Borneo; Sandakan (Douglas Cator—Brit. Mus.).

Allied to *N. rorida*, Walk.

Genus PARATELLA.

Paratella, Melich., Ann. Hofmus. Wien, xvii, p. 117 (1903).

Type, *P. iodipennis*, Guér.

Paratella decolor.

Nephesa decolor, Walk., Journ. Linn. Soc. Lond., x, p. 176 (1868).

Cromna chlorospila, Melich. (part), Ann. Hofmus. Wien, xvii, p. 61 (1903).

Sepheua rufilinea, Melich. (part), loc. cit., p. 127.

Hab.—Mysol, Waigiou.

Closely allied to *P. intacta*, Walk.

Paratella amata.

Nephesa amata, Walk., Journ. Linn. Soc. Lond., x, p. 175 (1868).

Sepheua rufomarginata, Melich. (part), Ann. Hofmus. Wien, xvii, p. 129 (1903).

Hab.—Waigiou.

Paratella subcincta.

Paratella subcincta, Walk., MS.

Paratella umbrimargo, Melich., (nec. Walk.) Ann. Hofmus. Wien, xvii, p. 121, t. iv, f. 10 (1903).

Hab.—New Guinea, Ternate.

The species described and figured by Melichar as the *P. umbrimargo*, Walk. is not that species, but *P. subcincta*, Walk. Walker's MS. name therefore becomes available.

Paratella invasa.

Nephesa invasa, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 178 (1868).

Hab.—Waigiou.

Closely allied to *P. subcincta*, Walk.

Paratella umbrimargo.

Pæciloptera umbrimargo, Walk. (nec. Melich.), List. Hom. Suppl., p. 115 (1858).

Hab.—Sumatra.

KAYANIA, gen. nov.

Vertex transverse, much shorter than broad, centrally and laterally ridged; the anterior margin subtruncate, wider than basal margin; face about as long as broad, tricarinate, the sublateral carinations not reaching the posterior margin, and broader and less acute than the central carination, the lateral margins amply reflexed and sinuately narrowing towards clypeus; clypeus only slightly shorter than face, elongate, its apex truncate, broadly centrally ridged; pronotum longer than vertex, subconically produced between the eyes, lateral margins obliquely rounded, basal margin moderately concave; mesonotum tricarinate, the disk flatly raised; legs of moderate length, posterior tibiae with a strong spine near apex; tegmina less than twice as long as broad, costal membrane nearly as broad as radial area, the first transversely veined, two series of longitudinal veins on apical area, the outermost bounded by an almost straight series of transverse veins, the innermost irregular in size and bounded by a waved and sinuated series of short transverse veins, remaining area somewhat thickly transversely veined, claval area strongly granulose; wings about as broad as tegmina, two transverse veins before apex.

Type, *K. volens*, Walk.

Allied to *Sephena*, Melich., but differing in the shape of the face and the venation of the tegmina.

Kayania volens. (Pl. xxii, figs. 18, 18a.)

Nephesa volens, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 161 (1857).

? *Colgar volens*, Melich., Ann. Hofmus. Wien, xvii, p. 117 (1903).

Hab.—Borneo; Sarawak (Wallace—Brit. Mus.).

Genus SEPHENA.

Sephena, Melich., Ann. Hofmus. Wien, xvii, p. 123 (1903).

Type, *S. spargula*, Walk.

Sephena rufilinea.

Nephesa rufilinea, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 174 (1868).

Sephena rufilinea, Melich. (part), Ann. Hofmus. Wien, xvii, p. 127 (1903).

Hab.—Mysol.

Melichar has placed the *N. decolor*, Walk. as a synonym of this species, though he had previously (*loc. cit.*, p. 61) located it as a synonym of *Cromna chlorospila*, Walk.

Sephenia albescens.

Nephesa albescens, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 177 (1868).

Cromna chlorospila, Melich. (part), Ann. Hofmus. Wien, xvii, p. 61 (1903).

Hab.—Mysol; New Guinea.

Sephenia obtusa.

Nephesa obtusa, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 177 (1868).

Cromna obtusa, Melich., Ann. Hofmus. Wien, xvii, p. 61 (1909).

Hab.—New Guinea.

Sephenia consentanea.

Ricania consentanea, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 161 (1868).

——— *consentanea*, Melich., Mon. Ricanüd, p. 334 (1898).

Hab.—Mysol.

Walker has rather confused his description of the “transverse veins most numerous beyond the middle where they form five irregular lines”; his statement “fore wings . . . tuberculate at the base and along most of the length of the interior border,” clearly places it in the *Flatinae*; the type can be consulted in the British Museum.

Sephenia subjecta.

Nephesa subjecta, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 176 (1868).

Idume plicata, Melich. (part), Ann. Hofmus. Wien, xvii, p. 28 (1903).

Hab.—Celebes.

The *N. subjecta*, Walk. has the mesonotum (scutellum) distinctly keeled, a character which will distinguish it from *Idume* as diagnosed by Dr. Melichar.

Genus UXANTIS.

Uxantis, Stål, Öfv. Vet.-Ak. Förh., 1870, p. 776.
Type, *U. consputa*, Stål.

Uxantis plagiata.

Flatoides plagiatus, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 142 (1868); Melich., Ann. Hofmus. Wien, xvii, p. 227 (1903).

Hab.—New Guinea.

Uxantis semialbus.

Flatoides semialbus, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 142 (1868).

Uxantis pyralis, Melich. (part), Ann. Hofmus. Wien, xvii, p. 166 (1903).

Hab.—Aru; Mysol.

Genus ATRACIS.

Atracis, Stål, Hem. Afr., iv, p. 250 (1866).

Type, *A. pyralis*, Guer.

Atracis puncticeps.

Elidiptera puncticeps, Walk., List. Hom. Suppl., p. 73 (1858).

Hab.—Borneo.

Atracis intercepta. (Pl. xxii, figs. 15, 15a.)

Eurybrachys intercepta, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 156 (1857).

Hab.—Borneo.

Atracis surrecta. (Pl. xxii, figs. 13, 13a.)

Eurybrachys surrecta, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 156 (1857).

Hab.—Borneo ; Sarawak (Wallace—Brit. Mus.)

Var. a., Tegmina without the three black spots.

Hab.—Borneo ; Sandakan (Pryer—Coll. Dist.).

The type is figured.

Atracis vetusta.

Eurybrachys vetusta, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 156 (1857).

Hab.—Borneo.

Atracis conserta.

Eurybrachys conserta, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 155 (1857).

Hab.—Borneo.

Atracis rivularis, sp. nov. (Pl. xxii, figs. 14, 14a.)

Body and legs pale ochraceous ; vertex with the lateral margins (not reaching apex) and the apex bright ochraceous, a central longitudinal ochraceous line on posterior half ; pronotum with some irregular linear markings on lateral margins and a central line on basal half, piceous ; mesonotum irregularly speckled and suffused with piceous, these markings darker and more prominent on each side of lateral margins ; tegmina opaque greyish-white, basal third, some irregular markings beyond it and apical and subapical fasciate marginal suffusions, brownish-ochraceous ; wings milky-white, the veins ochraceous ; vertex about as long as broad, the lateral margins broadly ridged to the angles before apex ; face considerably longer than broad, the lateral margins strongly laminately reflexed and slightly sinuate, a short central longitudinal ridge at base ; mesonotum tricarinate ; abdomen above with a central longitudinal ridge ; tegmina about twice as long as broad, narrowing towards apex, the costal margin very strongly sinuately waved from about one-third from base.

Long. excl. tegm. 10 mm. Exp. tegm. 28 mm.

Hab.—Borneo ; Kuching (Hewitt—Coll. Dist.).

Franciscus, gen. nov.

Vertex twice as broad as long, apically truncate, centrally longitudinally and laterally ridged; face a little longer than broad, moderately narrowing towards clypeus, centrally longitudinally carinate for about half its length, basal margin truncate, lateral margins amply ridged and slightly sinuate; pronotum longer than vertex, narrowly rounded anteriorly, angularly concave at base, centrally longitudinally impressed on basal half; mesonotum tricarinate; legs moderate in length, posterior tibiae with a single strong spine; tegmina about two and a half times as long as broad, costal membrane very much wider than radial area, three series of transverse veins on apical area, defining three series of elongate cells; clavus somewhat coarsely granulose; wings with two transverse veins before apex.

Type, *F. fasciatus*, Walk.

Allied to *Bochara* Dist. from which it differs by the shorter and more transverse vertex, the different shape and structure of face, etc.

Franciscus fasciatus. (Pl. xxii, figs. 17, 17a.)

Flatoides fasciatus, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 141 (1868).

Atracis ? fasciata, Melich., Ann. Hofmus. Wien, xvii, p. 200 (1903).

Hab.—Waigiou, Mysol.

Species described by Walker in the Flatinae but not belonging to that sub-family.

Sub-fam. **Tropiduchidæ**.Genus **FICARASA**.

Ficarasa, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 162 (1857).

Type, *F. pallida*, Walk.

Ficarasa simplex.

Flatoides simplex, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 143 (1868).

Cromna peracuta, Melich. (part), Ann. Hofmus. Wien, xvii, p. 62 (1903).

Hab.—Ceram.

Sub-fam. **Delphacinæ**.Genus **UGYOPS**.

Ugyops, Guer, Voy. Ind-Orient. Bélanger, Zool., p. 477 (1834).

Hygiops, Amy. and Serv. Hist. Hém., p. 511 (1843).

Bidis, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 88 (1857).

Ugyops pictula.

Bidis pictula, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 150 (1857).

Bidis punctifrons, Walk., *loc. cit.*

Hab.—Borneo.

Fam. CERCOPIDÆ.

Genus SIALOSCARTA.

Sialoscarta, Jacobi, Mitt. Zool. Mus. Berl., iii, p. 23 (1905).

Considia, Dist. nec Stål, Rec. Ind. Mus., ii, p. 132 (1908).

Type, *S. cavata*, Walk.

Sialoscarta cavata.

Triechphora cavata, Walk., List Hom. Suppl., p. 343 (1858).

Sialoscarta concinna, Jacobi, Mitt. Zool. Mus. Berl., iii, p. 23

(1905); Schmidt, Stett. Ent. Zeit., 1910, p. 328.

Considia cavata, Dist., Rec. Ind. Mus., ii, p. 132 (1908).

Hab.—Java.

I had previously considered Jacobi's genus *Sialoscarta* as a synonym of *Considia*, Stål, but I quite agree with Schmidt in considering this a mistake and find that the *T. cavata*, Walk. has but one spine on the posterior tibiæ. This led me into a further mistake in placing another species outside *Sialoscarta*. The three genera *Considia*, *Sialoscarta* and *Colsa* are, however, *very* closely allied.

Sialoscarta krugeri.

Sialoscarta krugeri, Schmidt, Stett. Ent. Zeit., 1906, p. 279.

Colsa matanga, Dist., Rec. Ind. Mus., ii, p. 134. Pl. vii, f. 8 (1908).

Synonymic Notes.

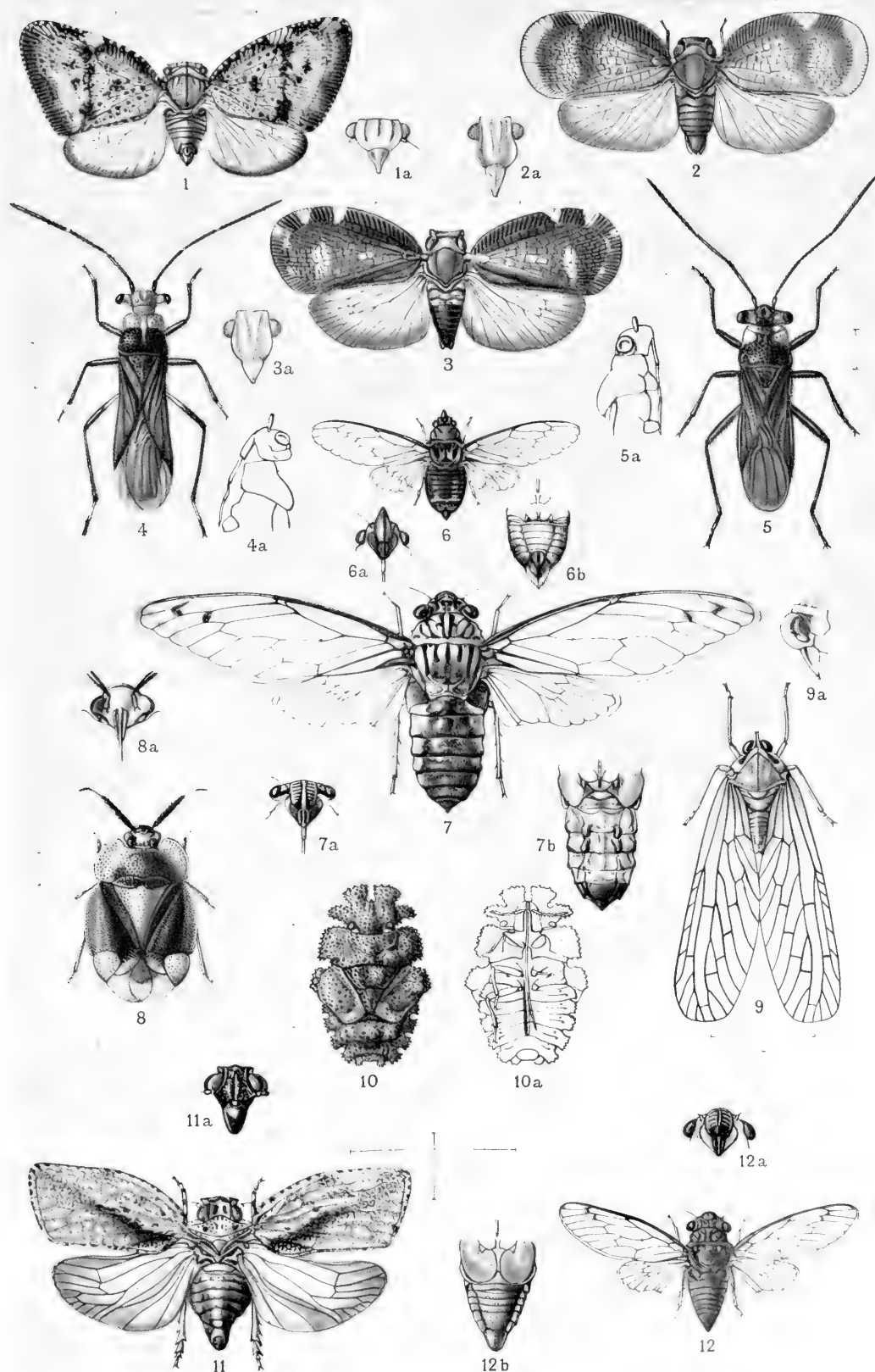
The generic name *Catara* was twice used by Walker in the same year (1868), in BLATTIDÆ and FULGORIDÆ.

Catara, Walk., Cat. Blatt., p. 52 (1868).

Catara, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 115 (1868).

As regards the Fulgorid name there is no difficulty as to the exact date of publication which is August 7th. Walker's Catalogue of Blattidæ was received in the British Museum Library on July 8th of the same year, so could not have been published later. Consequently the name is available for Blattidæ but not for Fulgoridæ. I therefore propose for the latter Fam. Fulgoridæ; sub-fam. Lophopinæ, the generic name of *Neocatara* which at present comprises two species, viz. :—

Type *Neocatara subdivisa*, Walk. (*Catara*), Journ. Linn. Soc. Lond. Zool., x, p. 115 (1868), Morty Isld., and *Neocatara philippinensis*, Dist. (*Catara*), Rec. Ind. Mus., iii, p. 172, Pl. xi, f. 12a (1909), Philippine Islands.



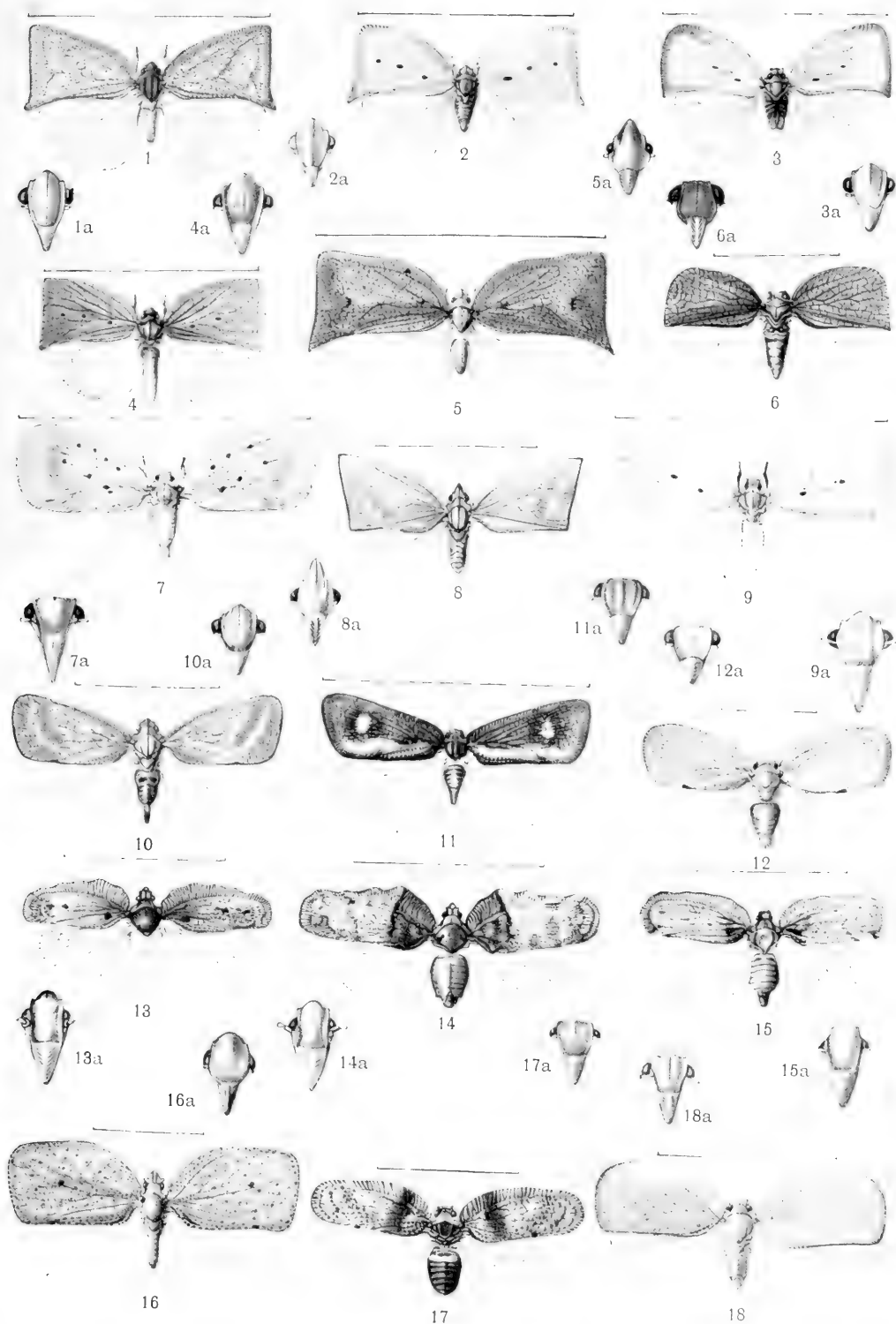
Horace Knight. del.

West. Newman proc.

1. RICANIA HEWETTI.
2. MINDURA CONFUSA.
3. " SIMIANA.
4. ABGARUS TYPICUS.

5. ÆTHALOTUS BORNEENSIS.
6. MOGANNIA MOULTONI.
7. PURANA CONSPICUA.
8. SKAPANA TYPICA.

9. AFAKIA DECISA.
10. SERBANA BORNEENSIS.
11. LOLLIIUS PRYERI.
12. LEMURIANA CONNEXA.



Horace Knight, del.

West, Newman pcc.

1. LAWANA MODESTA.
2. PHYMOIDES RUBROMACULATUS.
3. PARADAKSHA MEEKI.
4. NEOCROMNA BISTRIGUTTATA.
5. PHYLLYPHANTA ALBIDOSPARSA.
6. OXYANA SUBACUTA.

7. CIRCUMDAKSHA RUFOSPARSA.
8. COLGAROIDES EVERETTI.
9. NEODAKSHA QUADRIGUTTATA.
10. EUPHANTA CHLOROSPILA.
11. NEPHESSA SANDAKENSIS.
12. ORMENIS? BARAMIA.

13. ATRACIS SURRECTA.
14. " RIVULARIS.
15. " INTERCEPTA.
16. LOMBOKIA EVERETTI.
17. FRANCISCUS FASCIATUS.
18. KAYANIA VOLENS.

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